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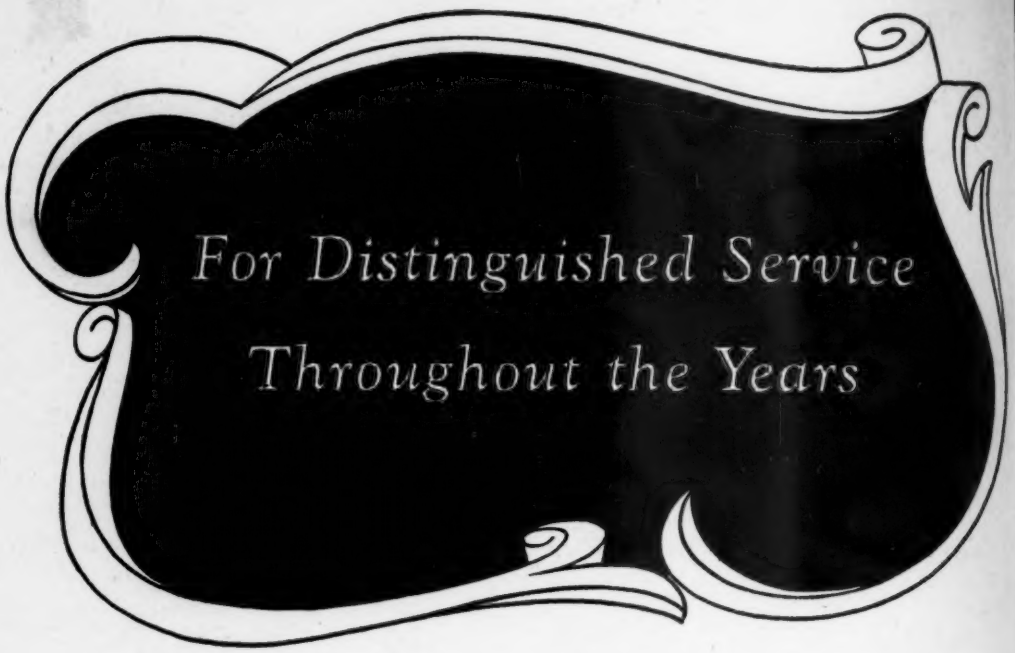

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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 28 JUNE, 1945 NUMBER 6

SYMPATHETIC OPHTHALMIA FOLLOWING SUBCONJUNCTIVAL RUPTURE OF THE EYEBALL*

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New York

Sympathetic ophthalmia has been recognized for at least 250 years. Randolph,[1] in an excellent historical review, showed that the disease was known in the latter part of the seventeenth century by Thomas Bartholinus, and later by Bidloo, Le Dran, Beer, and Demours. The last-named was the first physician in France who called attention to this malady and undoubtedly recognized it as early as 1818. Hirschberg[2] recorded that von Ammon, in his prize essay on iritis, in 1835, described two cases of sympathetic inflammation following injury and warned oculists to watch for this disease in cases of traumatic iritis of one eye. Mackenzie described sympathetic ophthalmia exhaustively in his textbook in 1844.

Sympathetic ophthalmia is a serious disease of the eyes, and fortunately very rare. Duke-Elder[3] estimated that it occurs in about 0.1 to 0.15 percent of clinic patients, and in about 90 percent of the instances follows perforating wounds of the eyeball or intraocular operations. A survey of the literature by R. Irvine,[4] in 1940, showed that sympathetic ophthalmia followed perforating wounds of the globe in 1 or 2 percent of the cases. Statistics on the incidence of sympathetic ophthalmia recorded by many authors show that 25 to 40 percent of the examples are associated with operations upon the eyeball. The disease occurs at all ages, and is found predominantly in males. Sympathetic ophthalmia has been described in cases of necrotic malignant melanoma of the uveal tract, following perforating ulcers of the cornea, and as an aftermath of contusion of the eyeball with subconjunctival rupture of the globe. Most of the few examples of sympathetic ophthalmia following contusion without rupture of the eyeball are open to doubt. The case of Delaney,[5] reported in 1931 as an instance of sympathetic ophthalmia unassociated with perforation or rupture of the eyeball, cannot be considered as correctly diagnosed, since the pathologic report by Major George Callender of the Army Medical Museum showed no evidence of the microscopic findings typical of sympathetic ophthalmia. In spite of the pathologist's report, the author concluded that this case was one of sympathetic ophthalmia because all medical investigations were negative. Lamb,[6] in 1932, reported an example of typical sympathetic ophthalmia in a six-year-old girl following nonperforating trauma. Joy,[7] in his analysis of 41 cases of sympathetic ophthalmia in 1935, included two instances in children following airgun injuries, the injured eyes pre-

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senting hyphema and no rupture of the globe. Trowbridge[8] recorded in 1937 a case of sympathetic ophthalmia as following a superficial injury by a piece of wood. Andersson,[9] in 1938, reported such a case in a child, only to find a tiny perforating wound of the sclera, choroid, and retina in a study of serial microscopic sections of the enucleated globe. Complete studies of sympathetic ophthalmia within the past 40 years have been made by E. Fuchs,[10] Gilbert,[11] Theobald,[12] Joy,[7] Woods,[13] D. H. Trowbridge,[8] Gördüren and Sohr,[14] and R. Irvine.[4]

The etiology of sympathetic ophthalmia is still unknown, but two main theories are favored: (1) ectogenous infection, and (2) allergy, probably to uveal pigment. Tuberculosis as a cause is becoming less tenable. Holst,[15] in 1941, reported five examples of sympathetic ophthalmia in healthy children following penetrating injuries of the eyeball. Since all these youngsters gave a negative response to intradermal tuberculin tests, the author concluded that these cases could not have been caused by the tubercle bacillus. H. Gifford[16] and A. Fuchs[17] were among the proponents of the theory of ectogenous infection by microbes or virus. Elschnig[18] introduced in 1910 the conception that sympathetic ophthalmia is due to antigenic resorption of uveal tissue from injury or disease, thence to the hypersensibility of the remaining portion of the uvea of the primarily diseased eye which were not influenced by the trauma, and primary inflammation as well as hypersensitivity of the normal uvea of the second eye. This theory was supported by Elschnig's co-workers, Salus[19] and Bail,[20] and in the excellent papers of J. S. Friedenwald[21] and Woods.[13,22] Gill[23] reported his findings to be consistent with the uveal-pigment-sensitivity theory.

The pathologic description of sympathetic ophthalmia was revealed by the classic studies of E. Fuchs.[10] At the present time, pathologists recognize a characteristic histopathologic appearance in sympathetic ophthalmia, and differentiate this from the findings in ocular tuberculosis and other types of chronic uveitis. The main features in sympathetic ophthalmia in examinations of microscopic sections of the involved eyeballs are small round-cell and epithelioid-cell infiltration of the uveal tract, giant cells in the infiltrated areas, and varying amounts of pigment phagocytosis by the epithelioid cells. There is often a considerable infiltration in the region of the injury or operation. Eosinophils and plasma cells may compose a part of the infiltrate. A plastic exudate is frequently present. The iris is rarely if ever involved alone. Its posterior layers are first infiltrated with lymphocytes and later with epithelioid cells. The ciliary body shows involvement mainly in the vascular layer. The choroid usually reveals early infiltration in the layer of large blood vessels. The choriocapillaris is the least-involved layer of the choroid. The pigment epithelium often discloses excrescences made up of epithelioidlike proliferations, known as Dalen-Fuchs nodules. The remainder of the retina is not a further participant in the inflammatory process except for round-cell infiltration of the walls of the blood vessels in some cases. The sclera often contains lymphocytes in the lamina fusca and in the emissaria. Weigelin[24] confirmed Fuchs's findings and added descriptions of 17 cases from the Tübingen University Eye Clinic. Samuels[25,26,27] further clarified the microscopic picture of sympathetic ophthalmia and showed that the characteristic infiltration in this disease develops in three stages: (1) lymphocytic infiltration in and around the walls of the large veins of the choroid,

(2) the formation of typical nodules containing giant cells in the center, surrounded by epithelioid cells and lymphocytes, and (3) the stage of formation of tumor-shaped masses of granulation tissue composed of the aforementioned cells.

The diagnosis of sympathetic ophthalmia is made in view of the history and clinical course of the specific plastic uveitis, in conjunction with the characteristic pathologic picture on study of sections of the enucleated eye. Without a pathologic examination, the identification of sympathetic ophthalmia may be correct, but is not proved and must be considered as presumptive. It is possible to have proved sympathetic ophthalmia, from a histologic point of view, in an injured eye or one operated on, with no evidence of uveitis in the uninjured eye. Trowbridge[8] found two examples in his series.

Schirmer,[28] in his classic study of sympathetic ophthalmia in 1892, emphasized the need for critical study of the cases reported in the literature. He found that many examples diagnosed as sympathetic ophthalmia were improperly classified. Of 21 records of sympathetic ophthalmia following subconjunctival rupture of the globe, only 6 could be considered as valid instances, and 2 of these could be questioned.

This study was prompted by my investigations of a patient with sympathetic ophthalmia following a subconjunctival rupture of the eyeball. I have reviewed the available literature dealing with this rare combination and have listed the reported cases. It seemed logical and reasonable to exclude instances in which a surgical procedure had been carried out subsequent to the injury and preceding the onset of specific inflammation of the uninjured or sympathizing eye. I have also rejected examples of sympathetic ophthalmia following rupture of the sclera in which the lens, iris, or both of these structures have been lost, as well as those cases in which the conjunctiva has been visibly torn. A few reports in the literature, such as those of Mooren,[29] Seidel,[30] and Rønne (quoted by Jensen[31]) give details which are inadequate for a well-grounded diagnosis. Joy,[7] in his series, included a case of subconjunctival rupture of the globe with a mild sympathetic ophthalmia five weeks after the injury, but the data given were too scanty to warrant inclusion in the list below.

Case reports from the literature

The following group of cases are presumptive or proved cases of sympathetic ophthalmia following subconjunctival rupture of the eyeball which have been reported.

1. Reported by Jacob[32] in 1874.

A farmer was accidentally struck in the right eye by the finger of a person who was accosting him. The vision of the injured eye was immediately blurred. The left eye became inflamed seven weeks later, resulting eventually in a blind left eye, with adherent pupil, tremulous iris, and cataract. The author's examination of the patient's right eye at a later date showed the lens dislocated beneath the bulbar conjunctiva above and nasally, no trace of iris, a retina which was in good condition, and useful vision with the aid of a convex lens.

2. Reported by Ayres[33] in 1876.

A man, aged 38 years, ran against a pump handle, striking his right eye. The vision of this eye was immediately reduced to light perception. The vision of his left eye began to fail six weeks later, with pain in both eyes. Examination of the right eye showed an indirect rupture of the sclera, extending around the globe nasally. There was bluish-black hemorrhagic material beneath the bulbar con-

junctiva nasally, and the lens was seen as a rounded elevation under the conjunctiva anterior to the caruncle. The anterior chamber was deep. A small segment of iris was seen inferiorly. The media were turbid. Vision was equal only to detect hand movements. The left eye showed a dense pseudomembrane in the pupil, a shallow anterior chamber, complete posterior synechia, ciliary injection. The patient was hospitalized. Atropine was instilled into each eye three or four times a day. The vision of the injured eye improved to 15/40 by four months after the accident. The intraocular pressure of the left eye increased, with iris bombé and increased congestion. Iridectomy was performed on the left eye, with normalization of the intraocular pressure and disappearance of the ciliary injection. The vision of the left eye was practically nil.

3. Reported by Ayres[34] *in 1882.*

The patient was a man, aged 50 years, whose left eye was struck by the handle of a shovel or his own thumb. This eye sustained a subconjunctival rupture of the sclera, the wound being half an inch long, irregular, and directed upward. The anterior chamber was filled with blood. The vision of his right eye began to fail five weeks after the injury, and sympathetic iridocyclitis of the right eye was diagnosed. The patient was hospitalized for 2½ weeks and treated with atropine instillations and hot poultices. Examination 2½ months after the injury showed the vision of the left eye to suffice only for counting fingers at 3 feet. A grayish mass was seen in the vitreous. The vision of the right eye was 20/100. The right eye revealed moderate dilatation of the pupil, a posterior synechia downward and inward, and edema of the nerve head. One month later, the vision of the right eye had improved to 20/30. The condition of the right eye gradually ameliorated until its vision became normal. The left eye finally cleared, with vision equal to counting fingers at 14 feet with a +9.00D. sph., absence of the iris, and a reduction in the size of the vitreous coagulum.

4. Reported by Gunn[35] *in 1887.*

A man, aged 58 years, had the left eyeball ruptured by a cow's horn. The lens was dislocated beneath the conjunctiva in the upper inner ciliary region. The right eye became injected and its vision misty six weeks after the injury. There were posterior synechiae of the right eye. The left eye was enucleated. Vision of the right eye was 20/50, 11 months after the injury. Pathologic study of the left eye showed: lens in its capsule beneath thickened conjunctiva in the upper nasal ciliary region; iridodialysis opposite the site of the scleral rupture, which was closed with tissue not unlike the thickened conjunctiva over the lens; a small hyphema; a deep anterior chamber; and generalized thickening of the ciliary body and choroid.

5. Reported by Deutschmann[36] *in 1889.*

The patient was a woman, aged 40 years, whose right eye suffered a subconjunctival rupture of the globe from an injury by a cow's horn. The sight of the injured eye was lost immediately. Examination of the right eye revealed a subconjunctival rupture of the sclera superiorly, with iris prolapse beneath the conjunctiva and bloody exudate in the anterior chamber. The left eye became inflamed four weeks after the injury, and the vision of this eye became impaired one week later. Enucleation of the right eye was performed six weeks after the injury. At that time the left eye had vision of 20/200 and showed ciliary injection and fine posterior synechia. There was

little change in the left eye two months later.

6. Reported by Sachs[37] *in 1889.*

The patient, 48 years of age, suffered a scleral rupture of the left eye in the ciliary region, with subconjunctival dislocation of the lens and iris nasally, and incarceration of the ciliary body in the scleral wound. The subconjunctival elevation measured 8 by 3 mm. The right eye became inflamed seven weeks after the injury, and was found to have iritis. The left eyeball was removed 8½ weeks after the accident, and the iritis of the right eye subsided three weeks later.

7. Reported by Knapp[38] *in 1891.*

The left eye of a man, aged 45 years, was bumped by the head of a small pet dog. Examination of this eye 10 days later showed subconjunctival hemorrhages, an elevation beneath the nasal bulbar conjunctiva produced by a dislocated iris, intact conjunctival and corneal surfaces, a 3- to 4-mm. rupture of the sclera nasally, iris absent from the interior of the eye, lens in place, some blood in the lower vitreous, and visual acuity of 15/200. The right eye had always been weak, and its vision was 20/70 with a convex lens. The right eye became inflamed 25 days after the injury, with reduction of visual acuity. A progressive plastic uveitis of the right eye developed, with remissions and relapses, finally leaving vision of 1/200 and a pupil closed by a dense gray pseudomembrane. The vision of the injured left eye was 2/200 seven months after the accident.

8. Reported by Wadsworth (in discussion of Knapp's case) in 1891.

A boy, aged 12 years, suffered a subconjunctival rupture of the sclera in the ciliary region from an injury by a spitball projected from a toy gun. The uninjured eye became inflamed about three weeks after the accident. The injured eye was removed four weeks after the injury, but the sympathetic uveitis progressed to loss of vision of the patient's remaining eye.

9. Reported by Meyer[39] *in 1896.*

The patient was a woman aged 43 years, whose right eye was injured by a cow's horn. This eye was painful and inflamed, but quieted after several weeks, only to flare up again 10 months later. At this time, the left eye became painful, and the patient suffered from headache around this eye, and pain on attempting to read. Examination, 11 months after the injury, showed a shrunken right eye, with a scleral scar nasally, ciliary injection, an atrophic greenish-yellow iris, pupillary posterior ring synechia, and organized vascularized exudate in the lower pupil and in the posterior chamber. The left eye disclosed punctate deposits on the posterior cornea and on the anterior lens capsule, no posterior synechia, and a clear vitreous. Complete physical examination of the patient was negative. The right eye was immediately enucleated; rapid clearing of the intraocular inflammation of the left eye ensued and restoration of its vision to 6/6. Pathologic study of the right eye revealed infiltration beneath intact conjunctiva over a scleral wound in which iris was incarcerated, shallow anterior chamber, exudate extending from scleral wound to posterior chamber, hematogenous pigment and necrotic tissue under the conjunctiva and in the scleral rupture, young granulation tissue with some giant cells on the anterior lens capsule, infiltration of the ciliary body with dispersal of its pigment, thickening of the choroid, and detached retina. Coccuslike bodies were seen between the corneoscleral margins of the wound. This

globe showed a combined plastic and purulent iridocyclitis and choroiditis, indicative of a chronic and a recent inflammatory process.

10. Reported by Donaldson[40] in 1897.

A woman, aged 33 years, struck her right eye against the latch of a door. Examination of the injured eye showed a soft globe, a bluish swelling under the intact bulbar conjunctiva superiorly, blood in the anterior chamber, and vision of light perception. The left eye was normal. The right eye became painful, and there was bulging of the scleral wound. Enucleation was done 20 days after the accident. The microscopic study of the right eye disclosed a plastic cyclitis. The uninjured left eye became inflamed 47 days after the accident and 27 days after the removal of the injured right globe. The left eye had deposits on the anterior lens capsule. Physical examination of the patient gave normal findings. The woman was followed for five years during which her left eye suffered from recurring attacks of uveitis, worse after a bout of "catarrhal ophthalmia" which occurred three years after the injury and which left corneal scars. The vision of the left eye was 4/60 five years after the accident to its fellow eye.

11. Reported by Fuchs[10] in 1905.

The patient was a man, 33 years of age. One of his eyes was injured by a cow's horn. The sclera was ruptured and the lens was dislocated beneath the intact bulbar conjunctiva at the site of the rupture. Sympathetic uveitis began in the uninjured eye six weeks after the accident. Enucleation of the ruptured globe was performed seven weeks after the injury occurred. Pathologic study of the removed eye showed typical sympathetic ophthalmia.

12. Reported by Fuchs[10] in 1905.

The patient was a woman, aged 56 years, who suffered a subconjunctival dislocation of the lens from an injury by a cow's horn. The uninjured eye became inflamed six weeks after the injury, and the ruptured globe was enucleated several days later. It showed characteristic sympathetic ophthalmia on microscopic examination.

13. Case of Dimmer reported by Fuchs[10] in 1905.

The microscopic sections of the enucleated eyeball showed a subconjunctival scleral rupture. The iris which lay beneath the conjunctiva was more heavily infiltrated than the uvea in the eye.

14. Reported by Weigelin[24] in 1910.

The patient was 41 years of age. One eye was injured by a cow's horn. The damaged eye suffered a subconjunctival rupture of the sclera, with dislocation of the lens beneath the conjunctiva, and traumatic aniridia. Sympathetic uveitis of the fellow eye began 44 days after the injury, and enucleation of the injured globe was carried out three days later. Pathologic study of microscopic sections of the removed eye showed rupture of the sclera superiorly, with lens and iris lying beneath the conjunctiva. The subconjunctival mass was heavily infiltrated with small round cells. The infiltration extended around the lens and contained epithelioid cells and round cells. The ciliary body and choroid showed lymphocytic infiltration with sparse epithelioid and giant-cell deposits. Vessels extending through the sclera showed perivascular infiltration with lymphocytes.

15. Reported by Weigelin[24] in 1910.

The patient, 61 years of age, suffered an eye injury by a cow's horn, with en-

suing subconjunctival rupture of the sclera and subconjunctival dislocation of the lens. The entire iris lay beneath the conjunctiva outside the globe. Sympathetic inflammation of the fellow eye began four months after the injury, and the hurt eye was removed seven days later. Microscopic study of this eye showed the subconjunctival mass to be heavily infiltrated with lymphocytes, epithelioid cells, and some giant cells. The intraocular tissues revealed only moderate infiltration of the ciliary body and choroid.

16. Reported by Hussels[41] *in 1914.*

The patient suffered an injury of the left eye from a cow's horn. The right eye became inflamed five weeks later, and the left eye was then enucleated. Studies of microscopic sections of the removed globe showed typical sympathetic ophthalmia. The right eye gradually cleared and recovered good vision, revealing, however, yellowish and pigmented areas of the fundus.

17. Reported by Steitz[42] *in 1935.*

An adult male injured his right eye with a broom handle. The vision of the injured eye was lost at once. Local treatment and dressings were applied. The left eye developed pain and blurring of vision two months after the injury. Examination of the right eye showed ciliary injection, a prominence nasally beneath the bulbar conjunctiva, a cloudy anterior chamber, absent iris at the nasal limbus, aphakia, hemorrhage on the anterior face of the vitreous, and vision equal to defective light projection. The left eye disclosed slight ciliary injection, hyperemia of the iris, a posterior synechia nasally, and visual acuity of 5/15. The right eye was enucleated. The inflammatory process in the left eye increased, with gradual failure of vision, total synechia, and cataract. Microscopic study of the removed eye showed two subconjunctival scleral tears in the upper nasal quadrant with incarcerated iris and ciliary body. The lens, surrounded by connective tissue that was heavily infiltrated with lymphocytes and plasma cells, lay beneath the conjunctiva across the scleral wounds. Connective tissue, filled with plasma cells and epithelioid cells, occupied the space between the lips of the scleral tears. The iris and ciliary body were infiltrated, with occasional groups of epithelioid and giant cells in the uveal tract. The choroid was detached anteriorly by hemorrhage, and contained plasma cells up to the choriocapillaris. The retina was separated nasally and temporally.

18. Reported by the author[43] *in 1943.*

This patient was presented before the Ophthalmologic Section of the New York Academy of Medicine in a brief report. A detailed description of this interesting case is given below, together with a drawing and photomicrographs.

REPORT OF THE AUTHOR'S CASE

E. L. G., a white woman, aged 70 years, was seen on November 22, 1941, because of a "growth" of her left eye and failing vision of her right eye. She was referred to me by Dr. John Russell Twiss. The patient stated that the vision of her left eye had been poor since the age of 18 years, when this eye suffered from "keratitis and recurring intraocular hemorrhages." The onset of her present illness followed a fall eight weeks before I examined her. She said that she had struck her left temple region, and that a severe hemorrhage appeared in her left eye, followed by the presence of an elevated "growth" on the nasal side of the eyeball. Four weeks later, the vision of her right eye became obscured by "cobwebs," and

she consulted a local oculist who prescribed atropine drops and hot compresses, and advised removal of her seven remaining teeth. The extraction of the teeth had no effect upon her eyes, and the vision of her right eye failed rapidly.

Examination of her eyes, eight weeks after her fall, showed an inflamed soft right eye, with a plastic exudate in the anterior chamber, many posterior synechiae, incipient senile cataract, a cloudy vitreous, and vision equal to perception of hand movements. The left eye disclosed marked congestion, a central corneal opacity, a projecting mass of inflamed prolapsed iris beneath the bulbar conjunctiva in the lower nasal quadrant, a yellowish rounded subconjunctival mass superior to the dislodged iris, normal intraocular pressure by palpation, and vision equal to the perception of light.

Fig. 1 (Perera). Photograph of artist's drawing of patient's left eye, showing prolapsed iris beneath bulbar conjunctiva and luxated lens above this.

A thorough medical investigation by Dr. Twiss revealed a mild chronic disease of the tonsils, obesity (weight 182 pounds), hypertensive cardiovascular disease without evidence of cardiac failure (blood pressure 174/112), generalized arteriosclerosis, and chronic arthritis. Laboratory studies showed an elevated erythrocyte sedimentation rate (42 mm. at the end of one hour), clotting time of 4.5 minutes, bleeding time of 2 minutes, negative blood Wassermann test and Kline reactions, and normal urinalysis. The complete blood count revealed: RBC 4,360,000, hemoglobin 82 percent, WBC 6,800, color index 0.9. Differential white-cell count: polymorphonuclears 74 percent, small lymphocytes 20 percent, large lymphocytes 1 percent, monocytes 4 percent, basophiles 1 percent. Blood chemistry investigations showed: Urea nitrogen 8.5 mg. percent, sugar 142.8 mg. percent, cholesterol 224 mg. percent, and icterus index 7.9 units.

The patient was admitted to the Institute of Ophthalmology of Presbyterian Hospital, New York City, with the clinical diagnosis of subconjunctival rupture of the left globe, subconjunctival dislo-

cation of the lens and iris of the left eye, and probable sympathetic ophthalmia. Dr. A. B. Reese kindly examined this patient and agreed with the diagnosis. Several kodachrome photographs of the patient's left eye were made. From these, Mr. E. G. Bethke made a colored drawing which was photographed by Mr. A. Marfaing and is shown in figure 1.

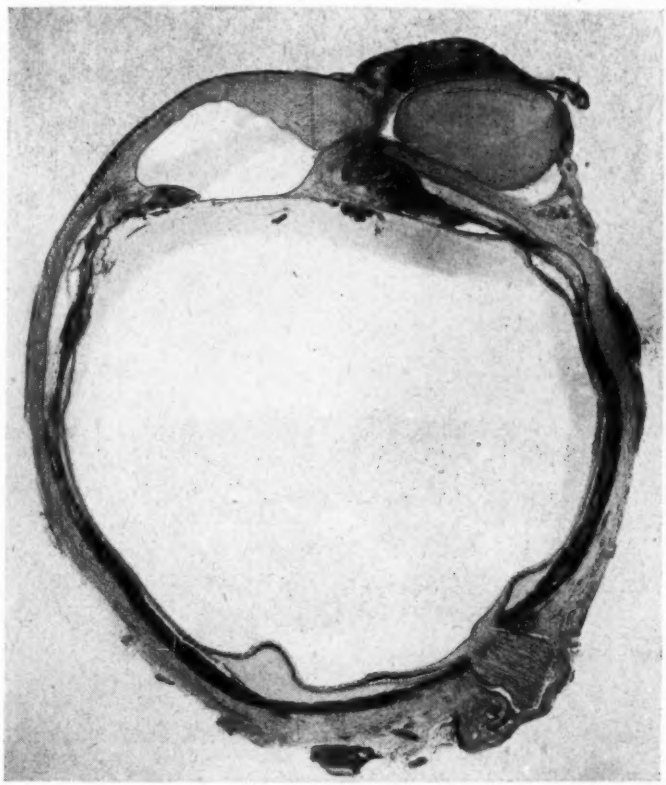

Fig. 2 (Perera). Photomicrograph of patient's left eyeball in cross-section to show intercalary rupture of globe and lens lying beneath the bulbar conjunctiva. A portion of the granulomatous mass of extruded iris tissue overlies the lens. Note the edematous swelling of the anterior lip of the scleral rupture and the flat detachment of the retina posteriorly. The ciliary body on the side of the rupture is heavily infiltrated, and the entire choroid is thickened and infiltrated.

Enucleation of the patient's left eye was performed 9½ weeks after the accident. Healing of the socket was uneventful. The right eyeball has gone on to shrinkage and degeneration, with yellowish-green discoloration of the iris, complete posterior synechia, dense cataract, and blindness. The patient has recently suffered from a cerebral hemorrhage with accompanying aphasia and hemiplegia.

Pathologic study of microscopic sections of the removed left eyeball is recorded in the files of the Department of Pathology of the Institute of Ophthalmology of Presbyterian Hospital as follows:

"The outer coat of the eyeball shows a rupture in the intercalary region nasally with the presence of the entire lens in its capsule and a mass of infiltrated uveal tissue lying beneath the nasal bulbar conjunctiva (figs. 2 and 3). The uveal tissue contains dispersed and disorganized

masses of pigment and a massive granulomatous reaction forming a tumorlike lesion made up principally of epithelioid cells and lymphocytes, with some plasma cells and a few giant cells (fig. 4). This mass of tissue lies inferior to the site of the lens and overlaps it without, however, invading the lens capsule. There is a considerable amount of pigment phagocytosis. The lens shows wrinkling of its capsule and peripheral vacuolar changes in its cortex at the equator. The interior of the globe shows extensive changes, characterized by a massive thickening and infiltration of the choroid and ciliary body with epithelioid cells, lymphocytes and rare giant cells (fig. 5). The cornea adjacent to the site of the rupture shows marked edema, with thickening and separation of its lamellas by fluid. The central cornea reveals loss of Bowman's membrane and the presence of a moderate amount of scar tissue in the superficial stroma. The intercalary region temporally, on the side opposite the rupture, shows a distinct rarefaction. The anterior chamber contains albuminous pink-staining fluid, and the entire iris is absent from the interior of the globe. On the anterior surface of the vitreous lies a thin fibrous membrane which continues nasally to merge with a dense connective-tissue mass lying on the internal surface of the ciliary body nasally and extending into the area of the interruption of the continuity of the cornea and sclera. The internal sur-

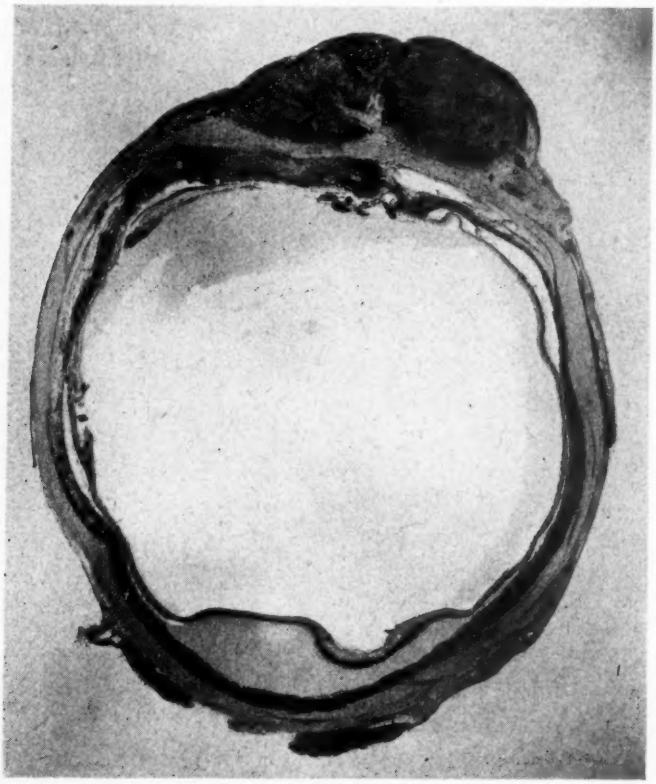

Fig. 3 (Perera). Photomicrograph of horizontal cross-section of globe to show tumorlike mass of granulomatous tissue containing disintegrating iris on the outer surface of the sclera. The retinal detachment and massive choroidal infiltration are seen inferiorly.

face of the ciliary body, especially nasally, shows disintegration and disorganization of the epithelium, both pigmented and nonpigmented, and an outpouring of leukocytes between the ciliary processes. The retina shows irregular areas of flat detachment over its entire extent, with a deeply staining homogeneous material separating the detached retina from the underlying degenerated pigment epithelium. Nasally the retina has been drawn forward over the pars plana of the cilary body. The macular region discloses deposits of pink-staining hyalinlike material in the external layers, forming cystlike spaces of the external plexiform layer. The optic nerve shows slight edema of the disc and a slight lymphocytic infiltration of its pial sheath. The vitreous reveals some areas of hemorrhage on the surface of the ciliary body nasally and beneath the membrane anteriorly.

Conclusions. This eye, which is the seat of old corneal scarring, has suffered a rupture at the nasal intercalary region with extrusion of the iris and the entire lens beneath the conjunctiva. The extruded uveal tissue has formed a tumorlike granulomatous mass of epithelioid cells, lymphocytes, and occasional giant cells. The interior of the globe shows a massive granulomatous infiltration of the uveal tract and a flat detachment of the retina.

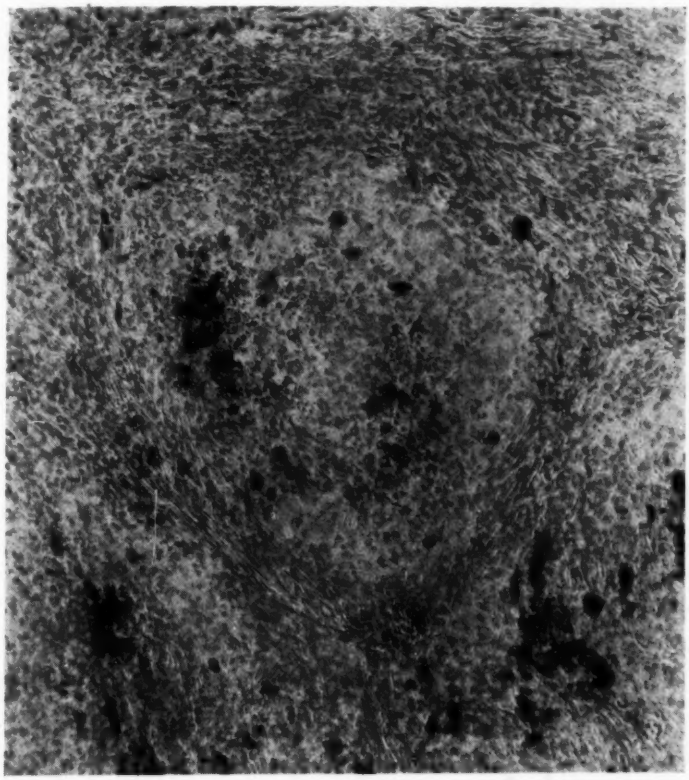

Fig. 4 (Perera). Higher power photomicrograph of an area in the granulomatous mass on the surface of the eyeball. In the center of the picture is a rounded area of giant cells and large epithelioid cells with disintegrated and phagocyted pigment derived from the broken-down iris. Around this are masses of epithelioid cells infiltrated with lymphocytes and plasma cells.

Pathologic diagnosis: Injuries—indirect rupture of globe; injuries—subconjunctival luxation of lens; sympathetic ophthalmia following injury; cornea—scars. (The pathologic report was made by the author, and kindly reviewed and confirmed by Dr. A. B. Reese.)

brief. In cases 4 and 9, the pathologic report of the enucleated eye was suggestive of the diagnosis of sympathetic ophthalmia. In cases 5, 6, 8, and 10, the account of the removed globe was inadequate to make the pathologic confirmation of sympathetic ophthalmia. In Donaldson's patient,

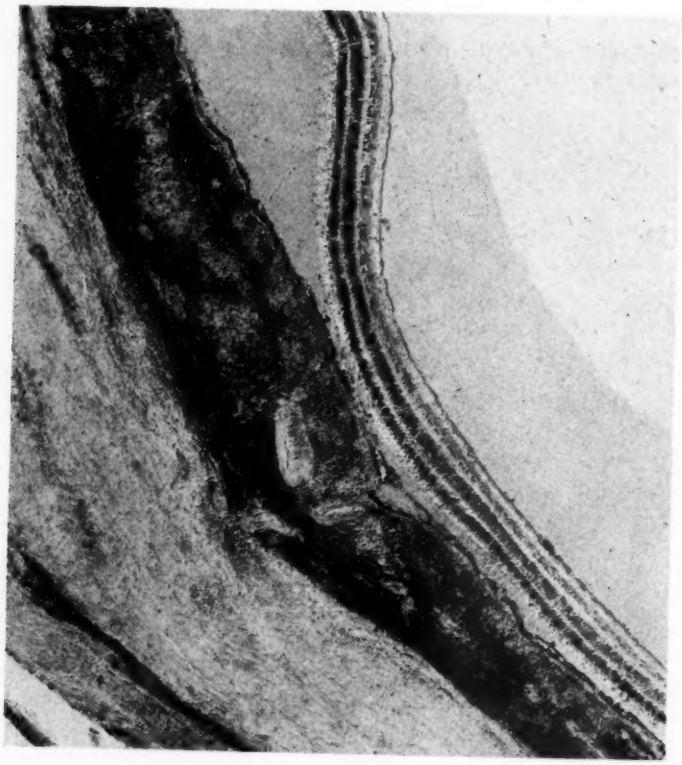

Fig. 5 (Perera). Photomicrograph of cross-section of posterior layers of eyeball, showing flat detachment of retina, massive infiltration and thickening of choroid with epithelioid cells, lymphocytes, and plasma cells, and dispersal of choroidal pigment.

Comment and Statistical survey

A careful critical analysis of the foregoing case reports leads to the conclusion that the diagnosis of sympathetic ophthalmia following subconjunctival rupture of the eyeball was proved by the pathologic examination of the injured globe in eight instances (cases 11, 12, 13, 14, 15, 16, 17, and 18). Of these, the clinical history of case 13 was not given, and the description of case 16 was very

case 10, the onset of sympathetic uveitis in the uninjured eye occurred 27 days after removal of the damaged eyeball. Enucleation was not performed in cases 1, 2, 3, and 7, but the histories of these patients are clinically characteristic of sympathetic ophthalmia. In cases 1 and 3 the authors stated that the iris was not seen when the inflammatory process had subsided in the injured eye; but in these eyes the lens was dislocated under the

bulbar conjunctiva in the first and probably into the vitreous in the second, and there was no other evidence that the iris was lost at the time of the injury.

The rarity of sympathetic ophthalmia following subconjunctival rupture of the eyeball makes its frequency difficult to evaluate. The Report of the Committee on Sympathetic Ophthalmitis of the Ophthalmological Society of the United Kingdom[44] in 1886 uncovered 211 examples of the disease. Of these, only three fall within the criteria which I have stated for sympathetic ophthalmia following rupture of the globe. Some authors, such as Alt,[45] Theobald,[12] Joy,[7] Trowbridge,[8] and Irvine,[4] reported large series of patients with sympathetic ophthalmia with no instances of cases falling in the group described in this paper. Of the 15 proved examples of sympathetic ophthalmia from the collection of the Department of Pathology of the Institute of Ophthalmology of Presbyterian Hospital, New York City, my case was the only one which followed subconjunctival rupture of the eyeball. A review of 715 cases of sympathetic ophthalmia, taken from series of cases reported in the literature, revealed that only 12 are among those covered by the title of this paper. It thus appears that about 1.6 percent of cases of sympathetic ophthalmia result from subconjunctival rupture of the eyeball.

In a discussion of subconjunctival luxation of the lens, Ask[46] emphasized the great danger of sympathetic ophthalmia, and advised, contrary to the opinion of many earlier writers, the immediate removal of the dislocated lens and prolapsed uvea, or enucleation. The incidence of sympathetic ophthalmia after subconjunctival rupture of the globe with subconjunctival luxation of the lens varied from 20 to 40 percent, according to different investigators, but most of their examples do not fit into the more rigid criteria which have been employed in this paper.

The sex distribution of the 18 cases reported in this thesis shows 8 males and 5 females, with the sex of 5 patients not given. Their ages varied from 12 to 70 years, and was not recorded in four instances.

TABLE 1

DATA FROM 18 CASES OF SYMPATHETIC OPHTHALMIA FOLLOWING SUBCONJUNCTIVAL RUPTURE

Case	Sex	Age	Time Interval before Onset in Uninjured Eye
1	male	—	7 weeks
2	male	38	6 weeks
3	male	50	5 weeks
4	male	58	6 weeks
5	female	40	4 weeks
6	—	48	7 weeks
7	male	45	25 days
8	male	12	3 weeks
9	female	43	10 months
10	female	33	47 days
11	male	33	6 weeks
12	female	56	6 weeks
13	—	—	—
14	—	41	44 days
15	—	61	4 months
16	—	—	5 weeks
17	male	—	2 months
18	female	70	4 weeks

The interval of time between the rupture of one eyeball and the onset of inflammation in the uninjured eye varied from 3 weeks to 10 months. The cause of the scleral rupture was injury by a cow's horn in 8 patients, contusion from other objects in 8 cases, and unknown in 2 instances.

Discussion

In all patients with subconjunctival rupture of the sclera, it is difficult if not impossible to exclude the possibility of an unnoticed minute wound of the conjunctiva. Even serial microscopic sections of the enucleated eyeball might not reveal a tiny tear of the conjunctiva which had healed during the interval of time between the injury and the removal of the globe. Since it is known that an infective

agent or virus can pass through intact conjunctiva, the presence or absence of a tiny conjunctival wound bears no weight in casting light upon the etiology of sympathetic ophthalmia.

My study is in accord with the findings of most writers that there is incarceration of lens or uveal tissue in nearly all instances of sympathetic ophthalmia, whether resulting from perforating traumatic or operative wound or from subconjunctival rupture. This fact, together with the certainty that sympathetic ophthalmia does develop in some patients after subconjunctival rupture of the globe, tends to favor the theory that allergy to uveal tissue or pigment plays a part in the etiology of sympathetic ophthalmia.

As Meller[47] has pointed out, there may be need for changing our conceptions of sympathetic ophthalmia, which may be present in cases other than those with perforating injuries. One form of so-called idiopathic uveitis may be idiopathic sympathetic ophthalmia, developing in patients whose uveas, injured through causes other than perforating wounds, have become sensitive to the etiologic agent of this disease.

The histologic features of sympathetic ophthalmia, including the widespread pigment phagocytosis, are compatible with the allergy theory of its causation, as Friedenwald[21] and Woods[22] have emphasized. My microscopic studies of the 15 examples of sympathetic ophthalmia in the collection at the Institute of Ophthalmology are consistent with their work.

Summary

A brief survey of sympathetic ophthalmia is given. This includes its incidence, the rarity of its occurrence following subconjunctival rupture of the eyeball, a short discussion of its etiology, and a presentation of its pathologic findings.

The need for a critical study of the cases reported in the literature as examples of sympathetic ophthalmia is presented.

Records of patients with sympathetic ophthalmia following subconjunctival rupture of the eyeball have been reviewed.

This paper deals only with uncomplicated examples of sympathetic ophthalmia resulting from a subconjunctival rupture of the globe, including the complete report of the author's case. It seemed logical to exclude instances of surgical intervention following the injury, as well as those cases in which the conjunctiva was visibly torn, or an intraocular structure was lost at the time of the injury.

Of the 18 cases culled from the literature, only 8 were proved by pathologic study to be examples of sympathetic ophthalmia following subconjunctival rupture of the eyeball. The remaining 10 cases were considered to be presumptively valid enough to be included.

The frequency, sex distribution, and age of patients with sympathetic ophthalmia following subconjunctival rupture of the globe are given, as well as the interval of time between the injury and the onset of inflammation in the uninjured eye.

It is impossible to eliminate the possibility of a minute conjunctival wound in these cases.

This investigation is in accord with the studies of most authors who report the incarceration of lens or uveal tissue in nearly all cases of sympathetic ophthalmia.

The findings of the author are consistent with the theory that allergy to uveal tissue plays a part in the etiology of sympathetic ophthalmia.

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WERNICKE'S DISEASE*
(ENCEPHALITIS HEMORRHAGICA SUPERIORIS)

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In 1881, Wernicke[1] described a clinical syndrome characterized by clouding of consciousness, varying ophthalmoplegias, and ataxia. Patients who were more severely affected went into stupor or into states of excitement, and many died within a few days. The cases Wernicke reported were all in inebriates, and he felt that some toxin, possibly alcohol, was the cause of the disease.

Shortly after this Jacobäus[2] described cases of the syndrome in which there was peripheral-nerve and spinal-cord involvement and he felt that Wernicke's description of the disease was too circumscribed. Many years later, Bender and Schilder[3] came to the same conclusion.

Although all the early cases reported were in alcoholics, Jacobäus advanced the idea, without offering proof, that alcohol *per se* was not the cause of the disease but that some nutritional disturbance was a contributing factor. This view was further advanced by Bender and Schilder.

In the last decade many reports of the disease in nonalcoholic patients began to appear in the literature. Of 14 cases reported by Neuberger,[4] 10 had malignancy of the gastrointestinal tract and 4 had chronic gastritis.

Wagener and Weir[5] reported three cases, two of the patients had severe postoperative vomiting and one the pernicious vomiting of pregnancy; all three developed ocular-muscle paralyses. Campbell and Beggert[6] also reported the disease in patients suffering from chronic gastrointestinal disturbances and persistent vomiting from other causes.

Jolliffe and his co-workers[7] reported 27 cases of the syndrome that had been observed at Bellevue Hospital between the years 1935 to 1940; only 3 of these were in nonalcoholics. They concluded that some metabolic factors, rather than alcoholism *per se*, were the cause of the disease.

In 1938, Alexander and his co-workers[8] made a most important contribution to the understanding of the causes of this disease.

They found that if all the vitamins except thiamine chloride were fed to pigeons, the pigeons regularly developed Wernicke's syndrome. On the other hand, if all vitamins, except thiamine chloride, were removed from the diet, Wernicke's syndrome did not develop.

Von Grosz[9] reported muscle paralyses in cases of vitamin-B deficiency and they and Wagener[10] noted the rapidity of cure if large doses of vitamin-B were promptly given.

Pricket, Salmon, and Schroeder[11] produced peripheral-nerve degeneration in rats by feeding them diets deficient in vitamin B. Axelrod, Spies, and Elvehjen[12] ruled out riboflavin as a cause of the disease when they showed that the riboflavin content in the blood and muscles was the same in pellagrous as in normal controls. They also showed that in vitamin-B deficiency there was a lack of a co-enzyme factor which in some way affected the oxidation process in muscles.

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* Read before the Brooklyn Ophthalmological Society in February, 1945.

According to Veasey,[13] thiamine chloride is the antineuritic or beriberi-preventing factor in the vitamin-B complex.

It is now agreed that thiamine chloride is a catalyst for carbohydrate metabolism. If absent, carbohydrate metabolism is arrested at the pyruvic-acid stage; and, in fact, the amount of pyruvic acid is a measure of the deficiency. Pyruvic acid is toxic to nerve tissue, and its deleterious action is enhanced by the presence of other noxious agents, notably alcohol, and by diabetes and other toxemias, such as the toxemia of pregnancy. The most severe cases, particularly those ending fatally, are in the chronic alcoholics; hence the disease originally was thought to be due to alcoholism. Alchoholism results in a chronic gastroenteritis which interferes with vitamin and food absorption and it also causes damage to the liver, an organ which plays a vital role in vitamin metabolism.

The pathologic changes in this disease have been extensively studied. According to Jolliffe, the lesions are confined to the periventricular gray matter, and are characterized by small foci of degeneration and varicose deformities of the blood vessels. There is subacute necrosis of the adjoining parenchyma, and small petechial hemorrhages are frequently found throughout the lesions. The areas most constantly involved are the nuclei of the thalami, hypothalami, and mammillary bodies. The region of the midbrain, especially the third and fourth nuclei, the nuclei of the vestibular nerves, and the dorsal nuclei of the vagi are also frequently involved.

Gamper[14] pointed out the constancy of involvement of the mammillary bodies in the Korsakoff syndrome, a condition due to alcoholism.

Ecker and Waltman[15] stated that the lesions in Wernicke's disease are most common in the gray structures of the brain near the third and fourth nuclei and in the region of the aqeduct of Sylvius.

The treatment is thiamine chloride in large doses. Pricket, Salmon, and Schroeder showed that the disease could be cured only in its early stages. Later, damage to the nerves becomes irreversible, and even massive doses cannot cause regeneration of the nerve tissue. In fact, the condition may progress and even end fatally.

Wagener made the interesting observation that the oculomotor paralyses are the most resistant to treatment, a fact shown in case 1. Conversely, Jolliffe noted that in those cases in which the ocular motor nerves showed signs of clearing, recovery from the disease was usually complete and rapid. This is exemplified in the third case here reported.

Wernicke's disease is a neuro-ophthalmologic disorder due to thiamine-chloride deficiency. Alcoholism and other diseases that interfere with food and vitamin absorption from the gastrointestinal tract make the condition more severe and more difficult to cure. Wernicke's syndrome may be more frequent than the reports seem to indicate, and in some of the cases in which there are ocular motor paralyses the latter may be a symptom of this disease, rather than the more commonly diagnosed "stroke" or "vascular sclerosis."

The recognition of this condition is important because early and adequate therapy is necessary to effect a cure.

Case reports

Case 1. D. Y., Chinese, male, single, aged 39 years, a laundry worker, seven years in this country, came to the clinic of the Jersey City Medical Center on November 17, 1939, with a history that about one year ago he noticed that his eyes were becoming prominent. He thought that the right eye was first in-

volved. During the past few months the prominence of the eyes had become progressively worse. He also noticed that he had to turn his head to see objects to either side of him.

Because of the prominence of the eyes, a thyrotoxicosis was diagnosed, but as several basal-metabolism readings, taken over a period of months, varied from plus 6 to plus 14, that diagnosis was dropped.

On June 17, 1940, the patient was referred to the Post Graduate Hospital for study.

Physical examination. The patient had a wide staring expression, such as is seen in advanced cases of thyrotoxicosis. The upper lids were markedly retracted. The exophthalmometer readings were 17 mm. right and 15 mm. left eye. There were a definite lid lag on movement of both eyes downward, and a complete absence of upward gaze. Both superior recti were completely paretic. The inferior obliques and the external recti were almost entirely paretic. The internal recti were moderately weak, but convergence was completely absent. The superior obliques were only mildly involved. The pupils were equal and regular and reacted to light and accommodation. The sensitivity of the cornea of the left eye was reduced, and there was marked congestion of the conjunctival veins. The fundi were normal. Except for numerous nodules on the skin, no other physical abnormalities were found.

The possible diagnoses were sarcoid, lymphoplasmia, and trichinosis. The possibility of thyrotoxicosis was considered and ruled out.

Thorough laboratory studies were made. X-ray studies of the chest, long bones, and skull were negative for pathologic change. Examinations for trichinosis were negative. Except for a mild anemia, the blood showed no abnormalities. The urine was negative for Bence-Jones proteins. Five stool specimens were positive for the ova of Clonorchis sinensis, and sections of several tumors removed from the skin showed them to be areas of mucinous degeneration of the subcutis.

The patient was discharged from the Hospital on June 28, 1940, and referred back to the outpatient department with no definite diagnosis.

Somewhat later, the possibility of Wernicke's disease suggested itself and the patient was placed on large doses of thiamine chloride and vitamin-B complex.

On January 3, 1940, the external recti showed increased motility and there was some improvement in the functions of the inferior obliques. By April, the exophthalmos we becoming less apparent, and there was further improvement in the functions of the ocular muscles. By January, 1941, all ocular movements, except upward gaze, were practically normal.

The patient was last seen on April 4, 1941. The staring expression due to the retraction of the lids had practically disappeared and, except for a slight weakness in upward gaze, the ocular-muscle paralyses had disappeared.

Case 2. M. H., a man, aged 22 years, an accountant, came to the Jersey City Medical Center on July 6, 1941, with the complaint that three months ago his eyes began to feel tired after work and that he had headaches in the evening. He developed dizzy spells during which objects in the room seemed to move to the left. About two months ago, he noticed that the left eye was unable to look to the left and that the left side of his face and forehead was paralyzed. About two weeks ago, vomiting without preceding nausea started. The vomiting was somewhat forceful and came about two to three

times daily. Since he had begun vomiting, the dizzy spells had become more frequent. There was no history of any acute illness preceding the onset of the symptoms. The past history was irrelevant.

The patient was admitted to the neurologic service with the following findings:

There was slight swaying on the Romberg test. The deep reflexes on the right were slightly hyperactive. The palpebral fissure of the left eye was narrower than that of the right. The pupils were equal and regular and reacted to light and accommodation. The external rectus and the obliques of the left eye were completely paralyzed. The left internal rectus was weak; the right internal rectus and the obliques were completely paralyzed, while the external rectus was very weak. The other ocular muscles were not affected. The fundi were normal. There was a complete peripheral facial paralysis on the left side. The neurologic and medical examinations were otherwise negative.

Triple-typhoid vaccine, starting with 25 million and doubling the dose each time was given on July 10, 11, 12, and 13, 1941, with fair febrile reactions.

The patient continued to grow worse and left the hospital on July 17, 1941, without a diagnosis. About six weeks later a high-vitamin diet together with large amounts of vitamin B_1 was given by mouth.

On November 1, 1941, the ocular motor functions had improved about 90 percent, and the left facial paralysis had disappeared. A month later the patient was completely cured of all paralyses and has remained so since.

Case 3. R. R., a woman married, aged 33 years, came to the outpatient department of the Brooklyn Hospital on September 18, 1944, with a history of menorrhagia and spotting for a long time. Examination showed vaginal bleeding, and she was admitted to the Hospital on the gynecologic service.

September 19th, under spinal anesthesia, a dilatation and curettage and a cauterization of a cervical ulcer were performed. While making rounds a few days later, it was noticed that the patient had ptosis of both upper lids and other ocular-muscle weaknesses. This, the patient said, had been present for several weeks prior to her admission to the Hospital. She was transferred on September 26, 1944, to the medical service with a diagnosis of myasthenia gravis.

Examination showed ptosis of both upper lids, very poor ability to converge, and weakness of all ocular muscles. There was cheilosis at the angles of the mouth, and the tongue was very red, smooth, and appeared to be enlarged. A diagnosis of vitamin-B deficiency was made.

Further history elicited the fact that the patient had been on a substandard diet for a long time.

Large doses of vitamin-B complex and a high-vitamin diet were prescribed.

On October 6, 1944, all the ocular-muscle paralyses and weaknesses had disappeared. There was still some cheilosis present at the angles of the mouth and the tongue was still moderately red and smooth. The patient was discharged from the Hospital as cured on October 7, 1944. By November 1, 1944, the cheilosis and glossitis had completely disappeared.

Summary

Three cases of superior encephalitis of the Wernicke type are reported, wherein there was no history of alcoholism, but which were due to dietary deficiency.

There were complete cures in the second and third cases and an almost complete cure in case 1. In the last-named, the disease had been present for a much

longer time and the symptoms were much more severe and had reached the irreversible stage, but fortunately to only a small extent. It is interesting to note that only in case 3 were other features of vitamin-B deficiency present; namely, cheilosis and glossitis.

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ANGIOID STREAKS IN THE DEEP LAYERS OF THE RETINA*

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Angioid streaks, those peculiar bands forming a more or less complete peripapillary ring with radiating branches, have been discussed for years. A host of concomitant signs have been written into the clinical descriptions, and emphasis has often been placed on them as though they were a distinctive part of the disease.

Numerous theories have been advanced to explain them. Some of the discarded ones have been slightly changed and reintroduced, but since the advent of the rupture of Bruch's membrane theory many writers have accepted it as a proved fact. I am not as yet convinced that it is more than a hypothesis, for, obviously, it does not explain all cases. Some papers have been published that lead the uninformed to believe that the rupture and the accompanying pseudoxanthoma elasticum are part of the same process. This certainly is not true in all instances.

An extensive review of the literature is not included for two reasons: first, because some cases have been reported more than once by different recorders, causing considerable duplication, and, second, the work has been very well done by Scholz. He not only compiled the bibliography but also published several fundus photographs illustrating small streaks, very broad ones, macular degeneration, and choroidal hemorrhage. His review does not register the work of Dimmer and Pillat, who published the first book of fundus photographs which includes several angioid streaks, nor does it mention those shown by me in 1932 and subsequently published. He has, however, done an excellent job, for anyone who has attempted a complete bibliography has found to his annoyance that some reports were overlooked.

After going over the Scholz review, the reader is referred to Wagener's enlightening, discursive paper.

Law presents an excellent article which commands attention because of his superior professional skill. What he describes as pigmentary debris and extracellular uveal pigment is sufficient, I believe, to explain the appearance of most of the streaks, and especially the great peripheral collections of round, red spots. I am, however, at a loss to understand why folds produce such a strange lack of even a semblance to a regular outline—that is, a moth-eaten edge. I agree with one of his conclusions, that "there is no necessity to invoke the occurrence of clefts in Bruch's membrane in explanation of angioid streaks, since none is present in this case."

Batten includes many of the accompanying diseases and suggests linking angioid streaks with them. This may prove to be true, but at this time, after going over many fundus photographs of vascular disease and a few of angioid streaks, I wonder if the theory has not outrun the facts.

It is futile to continue academic discussions when photographs furnish convincing proof. The streaks are flat. Vail made this point in 1928. The photographs I took of the eyes in the case which he presented at the meeting of the American Medical Association's Section of Ophthalmology seemed to substantiate his claim, as have all that I have studied since that time. I am unable to confirm the observations made by Clay, that pressure on the globe causes the streaks to disappear, nor have

* Presented at the eightieth annual meeting of the American Ophthalmological Society, at Hot Springs, Virginia, June, 1944.

I succeeded in establishing any familial tendency or relation to injury.

Without photographs, it is very difficult to be certain that a given streak has become larger or longer, or even to determine when it disappears, for an overshadowing retinal disease, such as common senile macular degeneration or retinal hemorrhage, may, for a time, completely obscure it. Later, when the blood or exudate has disappeared, the unchanged streak is found in its old location. There are, however, verified cases in which the streaks have widened, lengthened, and reached to the granular, spotted, peripheral fundus. In other cases, the faint, grayish-yellow limiting borders have become wider and wider until eventually only a delicate tracing of the red streak remained. The observer must be very careful to analyze each streak to avoid error in labeling an impression a fact.

Scholz reports that only 46 patients were seen for over a year. He referred to Oeller's patient, whom Fleischer, in 1938, reported as having had good vision for 23 years after the streaks were discovered. Later, macular involvement reduced it. This is supporting evidence of my contention that the presence of other signs is by no means proof of common cause. Cases have been reported wherein the streaks became thiner, darker, and less distinct. Zentmayer's case is illustrative.

Scholz states: "Of patients who were followed for more than a year, 33 percent showed an increase in the number of streaks; in 56 percent the condition remained unchanged; and in 10 percent the streaks decreased in number. The vision remained, on the whole, unchanged except as influenced by macular pathologic changes."

This is interesting, but I wonder what the conclusions might have been had they been based on the documentary evidence of photographs. I am inclined to believe that they would be different.

In some patients, as we will show, Segrist pigment spots develop on the streaks. The bands following choroidal or retinal detachment do not look like angioid streaks.

There is complete agreement among competent authors that the streaks are always beneath the retinal vessels, but there is some difference of opinion in relation to their position when choroiditis develops. I believe they are in front of the scars, and that they can be traced over the pigment or atrophy.

Narrow circumpapillary atrophy as such has nothing to do with the streaks, for it is a common finding in eyes without any pathologic condition, a fact readily conceded after the examination of a series of selected stereoscopic fundus photographs.

Furthermore, when degenerative macular lesions develop, they follow the usual clinical course of deep retinal or superficial choroidal hemorrhage, exudate, edema, expanding ring of blood, and increasing exudate. After many months the recurring hemorrhages stop, the exudate becomes organized, and the scar persists through life. I do not conceive this to be an integral part of angioid streaks.

The object of this paper is to record the observations made during the past several years on angioid streaks, with special details of the findings in four cases, one of which was under observation for a short time, the second for 4 years, the third for 8 years, and the fourth for 14 years.

Case reports

Case 1. M. S., a man, aged 36 years, healthy, single, in the Armed Forces, came for an examination because he was dissatisfied with his Army glasses.

Examination. Right eye: vision 20/100. With a —2.50D. sph. ⌯ —.50D. cyl. ax. 180° it was 20/20. The pupil was 3 mm. in diameter, regular, and active. The media were clear and the disc was slightly oval. The retinal vessels followed a common pattern and were normal. The inferior artery and vein paralleled each other for some distance until the artery crossed the vein without indentation or any variation in caliber. The superior temporal artery crossed in front of the vein and was without pathologic change. Surrounding the temporal and superior half of the disc was a pale, indefinitely outlined, narrow arc, the base of which was slightly uneven, thickest at the superior edge of the nerve-head. The outer border of this depigmented zone was the darker. There was a fine, red line beneath the retinal vessels starting from about the 5-o'clock position, and extending inferiorly to the 9-o'clock. This streak was not of equal diameter throughout, and it was not exactly in the same level—deepest at 9 o'clock and most forward at 5 o'clock. Near the nasal side of the disc there were a few interlacing angioid streaks. The background of the fundus was mottled with moderately heavy pigment. The dark, macular area was clearly and distinctly outlined; the center had a slightly granular appearance, and the vessels supplying it were of normal size and distribution.

Left eye: vision 20/200. With a −2.75D. sph. ⌯ −50D. cyl. ax. 180° it was 20/15. The disc was clearly and sharply outlined, with an increased prominence of the translucent nasal half. The border was clearly discernible, with a narrow temporal pigmented margin. The retinal vessels and the macular region were normal. The latter was outlined by fine, stippled pigmentation. The fundus background was mottled. The angioid streaks were arranged in an extremely delicate network, separated from the disc by a pale arc. They were, with the exception of a short isolated one, near the inferior temporal disc border, all confined to the nasal side, thin, red lines, more or less concentric to the disc. There were two dark spots almost as red as the streaks, one at the 3-o'clock and the other at 4-o'clock position. The peripheral fundus was negative in each eye.

Diagnosis. This was a case of very fine streaks unassociated with any other fundus change, thereby proving that it is possible to have angioid streaks in otherwise negative fundi.

Case 2. M. O'C., a woman, aged 30 years, married, has been under observation for four years. The only interesting point in her history was the fact that "10 years ago there was considerable question as to whether I should continue at school because my sight was defective." Two and one-half years prior to examination she lost her vision for one month. At that time, her tonsils and all her upper teeth were removed, although there was no evidence of dental disease. Her Wassermann reactions were negative.

Examination. When she first came under supervision the vision of the right eye was 20/30 and Type 1. Her total refractive error was +.50. The pupil was 3 mm. in diameter, regular, and active. The media were clear. The disc, sharply and distinctly outlined, bulged forward about 2 diopters. The swelling was translucent and, of course, the nasal side projected farther. Surrounding the disc was an interrupted pigment line with very slight general pigmentation in the inferior segment and a broad, irregular, oval, depigmented zone from the 8- to the 11-o'clock position. This, in its broadest dimension, was wider than the disc and faded imperceptibly into the normal sur-

rounding structures. The retinal vessels were of normal size and distribution.

Beneath them and surrounding the disc was a mesh of red streaks, varying in width from the widest at the 9-o'clock position to the narrowest at about the

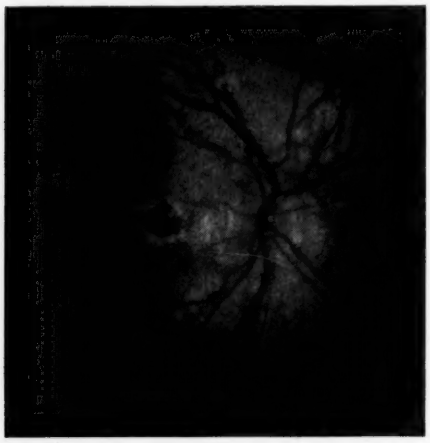

Fig. 1 (Bedell). Case 2. Right eye. July 27, 1940. Branched angioid streaks beneath the retinal tree; two large patches of choroidal pigmentation.

12:30-o'clock position. They all radiated from just beyond the margin of the nerve-head but did not come from exactly the same circumferential area. They were most numerous to the upper, inner side, where they formed an irregular network. Several streaks extended a considerable distance. One, passing anterior to a small choroidal scar, was more than 3 disc diameters in length, and more than twice the width of the largest vein, the end partly obscured by a gray covering and surrounding cloudiness. The other two were shorter and narrower.

There were four streaks in the inferior nasal quadrant. Some of them were the same width as the upper ones. A streak, extending almost vertically downward from the 6-o'clock position, was considerably broader but shorter, the surface was uneven and the color varied; in places it was quite red, in other spots practically as pale as the contiguous fundus. The longest streak started at about the 5-o'clock position, and passed almost straight downward; the outline was wavy, the edge serrated, the caliber variable, and after extending 4 disc diameters it merged into the red, granular periphery.

The streaks on the temporal side were divided into three groups; the superior temporal ones consisted of two major branches which arose from near the disc border, were beneath the corresponding retinal vessels, and in front of a small choroidal scar.

An interesting streak extended from the 9-o'clock position for about 3½ disc diameters. It was faint, on the whitish base of depigmented peripapillary atrophy. About 1 disc diameter from the disc there was a round dark patch of choroidal pigment with pale borders, over which the streak could be traced. Farther temporally, there was a short space where the red, granular streak was again clearly seen before it passed over a linear, choroidal scar above the irregularly pigmented macula to become a narrow, bright-red tortuous line before it entered the red speckled peripheral region.

Beneath the inferior temporal artery was a long, somewhat spearhead-shaped mass of dark, almost black, choroidal pigment. The retinal artery passed in front of it. Between the two largest choroidal scars, in the inferior temporal region, proximate to the disc, there was an irregular, granular, oblique red streak. On the nasal side, at about the 4-o'clock position a long streak extended obliquely toward the periphery and was traceable for 4 disc diameters. Part of its course paralleled the vein (fig. 1).

Vision of the left eye was 20/20, total refractive error +.50D. sph. ⊂⊃ + .25D. cyl. ax. 75°. The pupil was 3 mm.

in diameter, regular, and active. The media were clear. The retinal vessels were normal. The surface of the oval, elevated disc was uneven, with several colloid masses on the nasal side. These were translucent, and the pigment on the disc

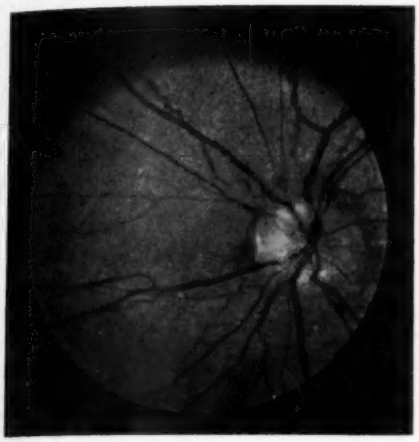

Fig. 2 (Bedell). Case 2. Left eye. July 27, 1940. Angioid streaks to the nasal side of the prominent disc.

could be dimly seen through them. Smaller collections were near the inferior disc border. The disc was clearly outlined by a faint arc of pigmentation. Beyond it was a paler band with a dark and finely granular edge. Surrounding the disc was a network of fine reddish streaks. These were smaller than those observed in the right eye, but otherwise they had the same characteristic tortuous outline, variable pigmentation, and, in places—particularly at the 8:30-o'clock position—there was a faint line about a portion of the streak. Altogether, there were 10 radiations from the circumpapillary ring. Some streaks were several disc diameters in length and were often parallel to and directly beneath the retinal vessels (fig. 2).

On the temporal side the circumpapillary ring was less defined, and there was only one broad oblique streak, which stretched from the 3:30-o'clock position for 3 disc diameters. It narrowed abruptly, and finally merged into the red granular dots which encroached upon the otherwise clear macular area.

Three years later. In the right eye there was a wider zone of choroidal absorption

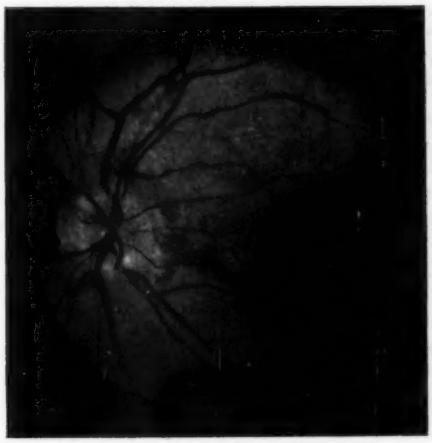

Fig. 3 (Bedell). Case 2. Left eye. September 22, 1943. A very large, flat streak curves about the inferior border of the macular area.

about the disc, the red streak near the macula was brighter. In the periphery of the fundus there were more fine red granules and the superior streaks were wider.

In the left eye, the changes had been slight; two were noteworthy: (1) At the end of the oblique streak which curved about the lower margin of the macular area the granules were more widely separated and (2) the faint, oblique, pale band near its termination had increased slightly in width, with irregular pigmentation in and about it (fig. 3). There has been no perceptible change in the past year.

CASE 3. A woman, aged 29 years, has been photographed at irregular intervals for the past eight years, and was referred by Dr. T. L. Terry of Boston, with the report that he had found no evidence of

osteitis deformans, but that she had a small patch of pseudoxanthoma elasticum on her neck.

Examination. On May 6, 1937, the patient seemed to be entirely well; she had never had any serious illness. The examination of her fundi, confirmed by the photographs, proves that new streaks do develop and that others undergo distinctive changes, such as an increase in the whitish streak margin, the formation of small, white, nodular masses, an occasional deposit of black pigment in or over the streak, and also fine white flecks near the distal end of the streaks where they merge into the region of red granules. The broad streaks in the right eye showed marked differences in color, in places a pale gray and in others dark red. In the left eye, there was a progressive broadening and lengthening of the streak and the oblique white band became whiter.

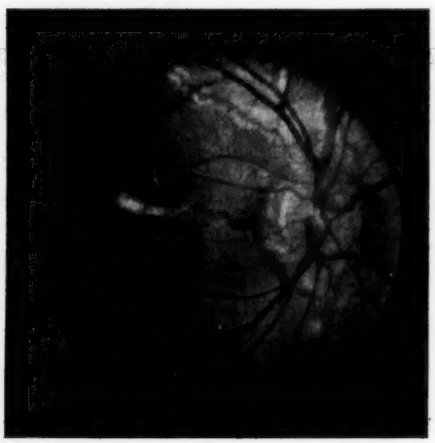

Fig. 4 (Bedell). Case 3. Right eye. May 6, 1937. Broad, circumpapillary streaks, and a white-walled superior temporal one. A wide, white band above the macula.

Fig. 5 (Bedell). Case 3. Left eye. May 6, 1937. Heavily pigmented streaks on the nasal side, and a very delicate, vertical one betwen the disc and macula.

Vision of the right eye was 20/50; with a −.75D. sph. it was 20/20. The disc was almost round, with a small, central excavation. The retinal vessels were normal. Completely surrounding the disc, but not at an equal distance from its border, was a broad dark streak of brownish-red granules. From the upper edge where the band was closest to the nervehead, three streaks fanned outward. The broadest was short and divided into two parts about one-fifth disc diameter above the border. The longest and narrowest was at the 10:30-o'clock position, whereas at the 9-o'clock there was a long streak which passed above the macula and was partially concealed by an overlying long, linear, white scar (fig. 4). There were several small, pigmentary collections about the macula. From the inferior border a broad streak, consisting of what appeared to be dark red granules, had an irregular outline, and extended downward about 3 disc diameters. Fine white dots were near its frayed end. On the nasal side there were no radiations from the peripapillary band. All of the streaks were deeper than the retinal vessels.

Vision of the left eye was 20/30; with a −.75D. sph. it was 20/15. The pupil was 3.5 mm. in diameter, regular and active. The media were clear. The retinal

veins and arteries were of normal size and distribution. The clearly and distinctly outlined disc was surrounded by an irregularly pigmented ring similar to that in the right eye, but the branching angioid streaks were narrow and less pigmented.

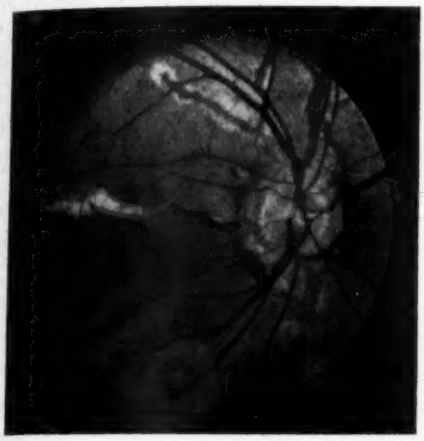

Fig. 6 (Bedell). Case 3. Right eye. February 5, 1944. Seven years later. The streaks are decidedly broader. The white lines along the streak have increased; the band in the macular region is smaller.

From the circumpapillary ring, there was an upward extension, twice the width of the vein, which tapered into a pigmented area similar to that described in the right eye. The outline of all of the streaks was ragged. There were two other streaks, one at the 10-o'clock and the other near the 6-o'clock position. On the temporal side of the disc there were three distinct dark-red spots, about three quarters of a disc diameter from the temporal border. A faint, white line, with a central, thin, reddish streak, extended from near the temporal border at the 2:30-o'clock position and passed above the macular region. There was a scarcely perceptible, fine streak with an extremely delicate prolongation, starting about one-half disc diameter from the temporal border of the disc, slightly above the white line and passing downward toward the 5-o'clock position (fig. 5).

Three years later, this particular streak was a jagged band the width of the largest vein. It tapered to a thin line several disc diameters from the inferior temporal border of the disc. Examination showed that from this streak, at about the 3-o'clock

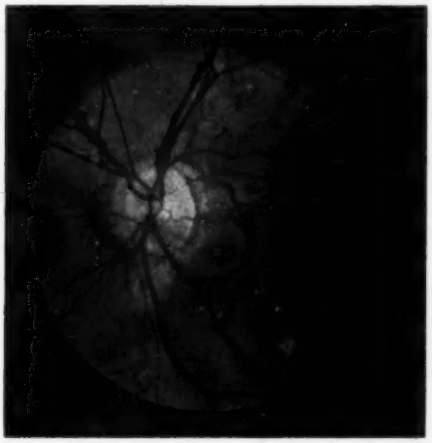

Fig. 7 (Bedell). Case 3. Left eye. February 5, 1944. Increased pigmentation in all streaks, especially marked in the one between disc and macula.

position, a branch was in the center of the pale white streak which was much less defined than formerly and, instead of being a continuous line, was broken by two whitish spots. The pale zone surrounding the disc had increased in width at the lower border, where a ragged streak and a small artery passed over it.

The streaks in the upper half of the fundus showed marked wall changes. Whitish spots developed over several of them and a few black spots, ophthalmoscopically similar to Segrist's dots, were present in one.

Later in the same year the oblique streak above the macula was less visible, but two distal whitish spots were found. The fine, granular, dark-red spots had spread from the temporal side until they were only about one disc diameter from the fovea.

By June 3, 1943 a white spot had de-

veloped alongside the enlarging, inferior temporal streak.

When last examined, February 5, 1944, the individual spots along the course of the temporal streaks were brighter, but through each the angioid streak could be traced. The gross pattern had, with the exception of the temporal streak, remained much as it was in the beginning (figs. 6 and 7).

Summary. The chánges in the left eye, which developed in eight years of observation, were the development of new streaks, of white spots along the course of several, a decrease in the visibility of the walls of one, an increased opacity near the inferior border of the disc and the encroachment of the red, granular, peripheral spots.

In the right eye, white spots formed along some of the streaks. The broad, white, irregularly outlined, superior macular streak became narrower and dark, granular spots collected on its surface.

When last examined, the vision of the right eye was 20/20; of the left eye 20/20. There was an irregularly enlarged, horizontally oval, blind spot in the right eye.

With the red light, the streaks were dark; with the yellow, chocolate brown; with the green, darker than with the yellow; whereas when illuminated with the unfiltered electric bulb they were dark, except where the light was reflected at an acute angle, when they were almost as red as the adjacent retinal vessels. The redness was most marked in the largest streak and best seen by focusing the light band on the retinal border of the streak.

The fourth case was recorded in the address of the Chairman of the Section of Ophthalmology, American Medical Association, in 1935. It has remained buried, for no writer on angioid streaks has ever mentioned it. I then stated that the streaks were either in the deep choroid or between the choroid and the sclera. Now, as a result of more experience, better instruments, and improved photographic film, I believe them to be more superficial.

This is a very important résumé for the patient has been under observation from his forty-second to his present sixty-fourth year. During this time he developed varicose veins in his legs, a left-sided hemiopia, and his blood pressure ranged from 70/50 to the present 178/110. He has not developed any skin changes. His kidney-function tests and Wassermann were negative.

Case 4. A vigorous-appearing printer was first examined on December 22, 1930. The Vision of the right eye was 20/15; total refractive error +.50D. cyl. ax. 90°. The pupil was 3 mm. in diameter, regular, and active. The media were clear. The clearly outlined normal-colored disc was surrounded by an irregular, partially depigmented zone, widest one-half disc diameter at the superior and inferior portions. The nasal inferior part of the disc was elevated, and the vessels curved over it. The retinal vessels were of normal size and distribution. Surrounding the disc, and forming the outer border of the pale circumpapillary area, was a brownish-red granular angioid streak from which many branches radiated. They were most numerous and shortest on the nasal side, where they formed a meshwork of broad bands. They were longest to the temporal side, where one streak paralleled the course of the temporal artery. The border of this and other streaks was pale. The macular area was clear (fig. 8).

Externally, the left eye was similar to the right. Vision was 20/20. The small disc was flat and clearly outlined by broad, angioid streaks, double on the nasal side, single on the temporal. From this red, granular ring, several broad bands were

projected, curiously frayed below, more defined above and nasally, and more granular on the temporal side. Frequently the streak seemed to lie on a pale band that was wider than the red portion.

The remaining part of the fundus was somewhat mottled; dark specks were within two disc diameters of the broad band that surrounded the nervehead. There was a definite ampulliform dilatation to the inferior nasal side of the disc. The streak extensions from this were granular; in places the pigment seemed to be absent, and the reduction in width of the streak was striking. Scattered about the disc were several granular spots of the same appearance but in no way connected with the streaks themselves. The macula was uninvolved, and the field of vision normal.

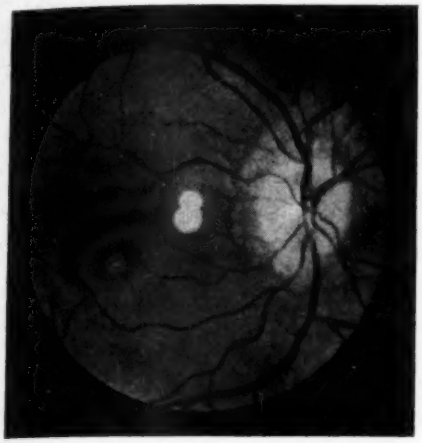

Fig. 8 (Bedell). Case 4. Right eye. December 22, 1930. Many flat streaks about the disc. Clear macula.

On May 7, 1937, the clearly outlined disc of the right eye was partially surrounded by a pallid zone, the outer margin of which was a reddish, granular streak with the extensions previously described. The darkest bands were in the inferior nasal quadrant, short, curved, thick. The temporal one was a yellowish-white stripe near the red and speckled macula (fig. 9).

By 1938, the macular area was pallid, with a slight speckling. The streak on the nasal side, extending from the 9-o'clock position, was about 2 disc diameters in length, with a very small, superficial, linear hemorrhage about the size of the largest retinal vein. The disc was pale and the surface rounded.

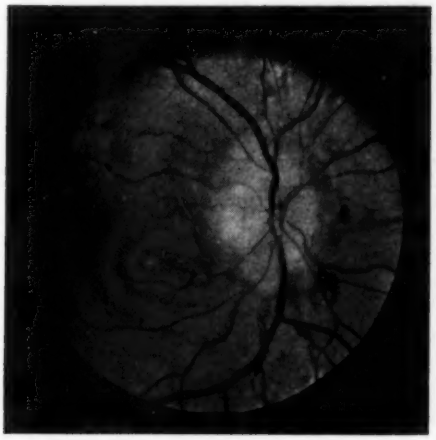

Fig. 9 (Bedell). Case 4. Right eye. May 6, 1937. Increased pigmentation and widening of the streaks especially above the macula.

No great alterations were observed in the right eye until 1943, when the vision was reduced to 20/50. There was an irregularly outlined edema of the macula, with a pink base and several dark spots roughly arranged in two circles, the inner about one-fifth disc diameter in size and the outer about four fifths.

There was a partial dissolution of the overlying retina, with a yellowish-gray edge and many very minute yellow spots. Between the macula and the disc were two fresh hemorrhages: one, a narrow line, fairly sharp and distinct; the other was one-fourth disc diameter in width. Both were beneath the retinal vessels. There was another extravasation on the superior temporal border of the pale disc

about one-half by one-fifth disc diameter in size on the same retinal level. The disc had not changed in color but near the lower border was a white triangle, the distal margin of which was a streak. The retinal arteries were reduced in caliber.

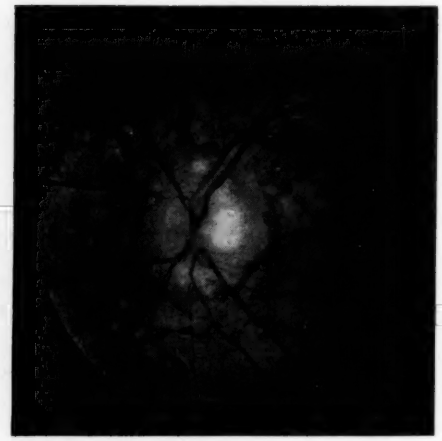

Fig. 10 (Bedell). Case 4. Left eye. January 3, 1939. Broad streaks about the disc. Irregular pigmentation above the macula.

The angioid streaks—a little wider, darker than the surrounding retina, and much darker than the fresh retinal blood—were still present, but because of the color of the entire fundus they were not so well differentiated.

In 1937, the streaks in the left eye showed practically no changes. The superior portion of the macular area was, however, definitely more mottled with several pale spots.

By 1939, this region showed a more diffuse pallor in a zone about five-sixth's of the disc diameter. The retinal vessels were uninterrupted, but the background was distinctly redder than the adjacent retina; the streak forming its upper border was narrow. The disc surface was uneven. There were several pale spots with the characteristic reflex of drusen. The superior streak had a fuzzy outline. The upper nasal streak was in some places three times the width of the largest vein. Its edge was frayed and it merged into the red, dotted periphery. The superior vertical streak became narrow before it reached the speckled area. The inferior streak, the most uneven in width, could

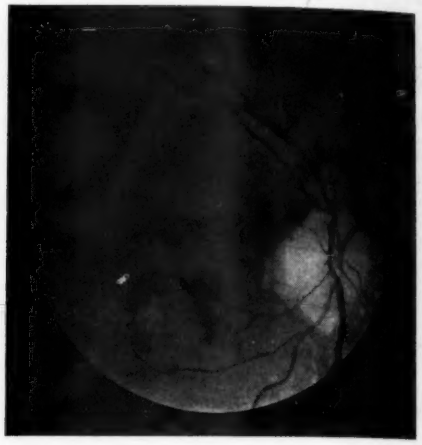

Fig. 11 (Bedell). Case 4. Right eye. April 19, 1943. Extensive retinal hemorrhages on the disc and between it and the macula with beginning macular degeneration. The streaks remain.

be traced to the red dots (fig. 10).

In 1943, the vision of the left eye was reduced to 20/200, unimproved with glasses. The disc was pale yellowish, but the border remained sharply outlined and the zone surrounding it was practically unchanged. The streaks were a dark reddish brown. There were a few isolated yellow accumulations about the streaks and a recent black spot at about the 2-o'clock position on the disc border. The streaks near 7 o'clock were distinct and more attenuated (figs. 11, 12, 13).

The angioid streaks were less sharply contrasted because of the macular edema, small superficial hemorrhages, and many fine white exudates dispersed about the lower half, most numerous and thickest near the disc. The macular region was similar in color but smaller than that in the right eye. The definition of streak

detail was as clear. The superior macular area streak was unchanged in size or length.

The differences between retinal hemorrhage and angioid streak were clearly seen.

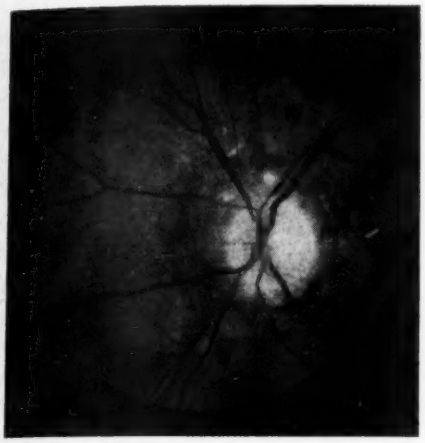

Fig. 12 (Bedell). Case 4. Left eye. April 19, 1943. Very large, broad, serrated streaks about the nasal side of the disc with irregular pigmentation to the temporal side.

Conclusions

Angioid streaks radiate from a circle surrounding the optic disc. The extensions from this ring vary in width or length; the individual pattern is distinctive.

Streaks may be very small, thin lines of a reddish color, or several times wider than the largest retinal vein and of a dark chocolate color. They may interlace and form a meshwork which is usually near the disc, or they may branch. They may fade into the adjacent tissues, have a frayed end which is sometimes overshot by a gray clouding, or extend into the reddish granular periphery. The center of the streak may be so thin and pale that it is almost invisible, or the streak may be completely covered by a yellowish-white band. There may be an increase or a decrease in the granules which reflect the color. Angioid streaks have been found in fundi that were otherwise negative.

During the progress of the disease, whitish or small black spots may appear in the streak.

The disc may be elevated and translucent.

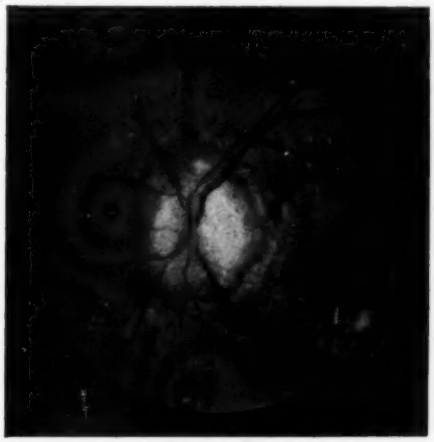

Fig. 13 (Bedell). Case 4. Left eye. April 7, 1944. Broad streaks. White specks partially surround the degenerated macula. Several fine hemorrhages.

When the disease has been existent for a long and unpredictable time, other fundus changes may become engrafted, notably massive pigment collections (usually dark brown or black), isolated small or extensive retinal and choroidal hemorrhages, or hemorrhages in and about the macula with the characteristic tendency to become absorbed when fresh ones appear, forming a circle or oval in which the retina first becomes edematous, then infiltrated, and, finally, permanently scarred.

It is probable that in all cases of advanced angioid streaks the equatorial zone and perhaps the extreme peripheral fundus are covered by fine, granular-appearing red dots. These spots have received very little attention in the literature and yet a careful scrutiny of the published drawings will show that some artists have seen them.

Several fundus photographs have been published. The earliest ones were in the Dimmer and Pillat atlas.

Too much notice has been given to the late or coincident signs and too little to the more accurate description of the life history of the streaks. Even in cases wherein the retina is the site of large hemorrhages it has been proved that the streaks are unchanged by the overlying blood.

A few observers have reported swelling of the nervehead. Law and others have recorded it, and it was present in two of the cases here cited.

No new theory is presented as to the cause of angioid streaks, nor is any theory so far advanced accepted without reservations.

Summary

Very few cases of angioid streaks have been observed for long periods, and, as far as I know, none of them has been repeatedly photographed.

The white or yellow lines which follow choroidal or retinal detachment have neither the color nor the texture of angioid streaks.

The streaks seem flat, but are not of uniform thickness, and the white spots which develop along some of them do not seem to be choroidal exudates.

Competent pathologists have examined many eyes with ruptures of Bruch's membrane, but have not found angioid streaks.

The theory that the streaks are blood vessels can, in the light of our present knowledge, be discounted, for no vessels have been found where the streaks develop and it does not seem probable that blood vessels could have the serrated edge so frequently seen in angioid streaks.

Streaks are presented here in which no hemorrhage was present and there was no evidence that there ever had been any.

Finally, even in the presence of very large retinal hemorrhages the streaks remain isolated and in on way connected with the fresh blood.

344 State Street.

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Discussion

Dr. Grady Clay, Atlanta, Ga.: In 1932, I first published in this country the association of angioid streaks and pseudoxanthoma elasticum, and since that time the reported association has become too frequent to be coincidental and therefore the pathologic changes must be related. Since that original report I have seen 63 more cases; 30 percent of these cases are associated with pseudoxanthoma elasticum and 15 percent are familial. I have found no other related disease in this

group. Nineteen patients in my series were hospitalized and a very careful study of this group revealed no other associated diseases. One with only a few streaks died recently from a hypertensive disease. An autopsy was obtained, also one eye. The complete report is not yet ready for publication.

I still believe the disease is a disease of the blood vessels associated with elastic-tissue degeneration, and that the earliest changes seen are hemorrhages and the formation of the streaks in the choroid. After this acute period has passed, which may be a year or two, hemorrhages are rarely seen and no more streaks develop, and from this time on there is a slowly developing choroidal atrophy in the areas of the streaks, and in these areas the streaks will entirely disappear. Why should there develop such a definite area of choroidal atrophy if this disease is not primarily a disease in the choroid and a blood-vessel disease?

In my opinion, the true pathologic picture is not yet known, and unless one is fortunate to secure an eye early in the course of the disease it will not be known, for secondary changes too greatly alter the pathologic picture.

Pseudoxanthoma elasticum occurs without angioid streaks, and vice versa. All cases that I have seen which show few streaks do not show pseudoxanthoma elasticum. The degree of skin involvement is in direct relationship to the degree of fundal pathology. A patient showing the most marked disease of the two conditions is a woman aged 52 years, and the skin condition was noted by her mother at 3 years of age. She has a niece, 15 years old, showing the two conditions in an exaggerated type—the youngest I have seen.

The disease is most frequently seen in the routine examination of the fundus for as it does not affect vision unless a streak should extend to the macula. In such cases hemorrhages are likely to occur and the end-result may resemble a disciform senile degeneration. I believe that many such macular lesions may be associated with angioid streaks.

Dr. William Zentmayer, Philadelphia, Pa.: From what has been said and shown here today, there seem to be as many opinions among the clinicians as among the pathologists as to what constitutes "angioid streaks." I should like to give a brief abstract of the clinical history of a typical case of angioid streaks of the retina observed over a period of 36 years. The case was reported before this Society in 1909, and was repeatedly shown over several years before the College of Physicians of Philadelphia. These are the fundi as painted at that time.

The patient, a man, aged 33 years, came to the Eye Clinic at St. Mary's Hospital in November, 1908, complaining of pain and dimness of vision in the right eye. This was due to a dendriform ulcer of the cornea. In the routine examination the angioid streaks in the retina were revealed. To summarize the findings: In the fundus of each eye there was a system of ramifying and anastomosing pigmented streaks which extended outward into the fundus from a similar band which surrounded crescents of grayish-yellow retinochoroidal disturbance about the disc. The streaks were beneath the retinal vessels and tapered toward the periphery of the fundus, which was the site of marked retinochoroidal changes. The color of the streaks was, in general, black, but in places there were islands of bright-red color. In O.D. there was a horizontally oval hemorrhage below the fovea.

In 1927, the patient was again shown at the College of Physicians and the following description of the media and fundi was given:

"O.D. Two vacuoles in upper part of lens, one large and one small. The disc yellowish gray and the nasal border veiled. The choroidal vessels in central area show varying degrees of sclerosis. There are several dense black pigment masses about 1 d.d. in size at the macula. The broken yellowed pigmented zone about the disc noted earlier has almost completely disappeared. There are still sections of fairly characteristic angioid streaks, following the course of the superior temporal vessels, near the equator below and one far out along the course of the superior nasal vessels. The latter is continued as a whitish streak running toward the disc. There is a black pigment mass lying beneath the superior nasal artery about 3 d.d. from the disc. Marked sclerosis of choroidal vessels was present. No active changes were noted.

"O.S. Media clear. Disc is about the same color as in the right eye. The veins are engorged. The sclerosis of choroidal circulation is more pronounced in the central area than in O.D. The pigment masses at the macula are also denser and larger than in the right eye. Of the pigment bands earlier seen, there remain only a section of one running horizontally a distance of about 3 d.d. near the equator, and one extending from upper margin of disc along the course of the superior temporal vessels. There is a greenish crescent about the nasal side edge of the disc bordered with a pigment band as originally seen.

"In both eyes, the periphery of fundus shows the pale yellowish dots and pigment originally noted.

"In both eyes the tension was normal.

"Vision: Right eye, 5/30. Left eye, 0.5/60."

In 1934, at the request of Dr. T. L. Terry, I had studies again made of the patient's physical condition to determine whether there was any evidence of Paget's disease. The roentgenograms were negative for evidence of Paget's disease, but there was some calcification in the region of the sella turica, probably within the internal carotid artery. At that time I again examined the patient's eyes. The description of the fundi showed that the changes noted in 1927 had progressed. There was no longer any evidence of the former angioid streaks and in the right eye there was an area beneath the superior temporal vessel suggestive of circinate retinitis.

The patient was seen again on May 18, 1944. O.D. There were a few vacuoles in the lens. The disc was somewhat waxy in appearance, but the gray zone which was formerly present about the disc has disappeared. Over most of the fundus there was a marked sclerosis of the choroidal vessels, with deep pigmentation of the intervascular spaces. In the macular region there were masses of dense pigment of irregular shape. In some portion of the fundus there was complete atrophy of the choroid.

O.S., media were clear. General appearance of the fundus about the same as in the right eye, only the areas of complete destruction of the choroid were most extensive and there was a denser massing of the pigment in the macular region. There were two extensive areas of almost complete atrophy, one along the course of the inferior nasal vessels and the second along the course of the inferior temporal vessels. Beneath the superior artery there was a vertical irregular area 3 d.d. in diameter, of whitish hue with a circinate appearance.

Vision: Right eye, 1/60. Left eye, 1/60.

About three months ago, the patient suffered a slight stroke affecting his speech and at the present has a systolic blood pressure of 210.

DR. F. P. CALHOUN, Atlanta, Ga.: In 1927, the late Thomas B. Holloway presented a paper before this Society on the subject of angioid streaks, and with his

characteristic thoroughness, reviewed the 56 cases then reported in the literature.

He noted that in four cases there was a familial tendency, and he commented that "if such an investigation had been made it is possible that the active coincidence would have been high."

At the same meeting I likewise presented "An unusual case of angioid streaks," and I pointed out that the family history of the patient strongly suggested a familial vascular disease or degeneration, since one brother had died at an early age from a heart attack, a sister died of intestinal hemorrhage, and a living sister was reported having a bilateral central choroiditis, which, indeed, might have been an atrophy from a hemorrhage and not from an infection.

In 1938, Law reported a similar family history in connection with angioid streaks, one member dying of intestinal hemorrhage.

I now wish to present the very unusual and extensive pedigree of a family in which angioid streaks, skin lesions (which clinically resemble pseudoxanthoma elasticum), and distal hemorrhages were the dominant symptoms.

I am in agreement with Dr. Bedell that the fundus picture which is described as angioid streaks and its complications involving the macular region may be due to a variety of causes, one of which is a familial vascular degeneration. I know of no better way to explain it than to accept Hagedoorn's thesis.

Dr. F. H. Verhoeff, Boston, Mass.: I understand that Dr. Bedell concluded from his study that the condition known in the literature as angioid streaks is not an entity, but that the streaks may have various origins. Lindner pointed out that pigmented streaks can form over sclerotic choroidal vessels, and I demonstrated the nature of the pigmented streaks that sometimes result from separation of the choroid. No doubt streaks may result from still other causes. Such streaks, however, do not produce the characteristic picture of the condition known as angioid streaks.

In 1928, when I reported the finding microscopically and macroscopically of many conspicuous streaks in the fundus of an enucleated eye, I felt sure that I had discovered the nature of angioid streaks, although none was present in the other eye. Up to that time, no microscopic examination of an eye with the typical ophthalmoscopic picture had been made, and my findings seemed to explain not only the streaks, but also the macular changes and the choroidal hemorrhages that sometimes occur.

The case, however, reported by Böck in 1938 has almost if not quite persuaded me that mine was not one of angioid streaks. Böck examined microscopically, *post mortem*, two eyes which had ophthalmoscopically shown typical angioid streaks. He not only failed to find choroidal ridges such as I had seen in my case, but did find in Bruch's membrane changes which seemed adequately to explain the streaks.

In 1939, Hagedoorn reported similar microscopic findings, but since the ophthalmoscopic examination was unsatisfactory his case is significant only when considered in connection with Böck's. Law, in 1938, concluded, after microscopic examination of an eye with angioid streaks, that the latter were due to retinal wrinkles. I feel sure that the findings he described were due to post-mortem changes.

Further examination of this eye should be made in the light of Böck's case. In Benedict's case, the eye, possibly on account of the way it was sectioned, showed neither choroidal ridges nor anything else that explained the streaks that had been seen ophthalmoscopically. The changes in Bruch's membrane found by Böck and

Hagedoorn were similar to, but generally more marked than, those I had often seen many years ago in senile eyes, and had described in collaboration with Dr. Sisson in 1926. The youngest patient in whose eyes we found them was aged 48 years. This fact is highly confusing because it suggests that angioid streaks should develop chiefly if not solely in senile eyes, whereas it is believed that they begin in early life even when they are first seen much later, for they have actually been observed in childhood. Other confusing facts are that, while many of the patients have pseudoxanthoma elasticum of the skin, a considerable number have well-marked Paget's disease of the bones, and that although a few have neither of these conditions, no case has been described in which the patient had both.

Dr. Ralph I. Lloyd, Brooklyn, N. Y.: Rayner Batten has some very beautiful black-and-white and colored drawings of cases in a family seen over a period of years, but they do not compare with Dr. Bedell's stereoscopic kodachromes. One of the French authors has observed several members of a family over quite a period, but the illustrations are sketches and not well done. I will take your time just long enough to show the fundi of three sisters to emphasize the fact that there are many cases of macular degeneration seen, but, if there are no angioid stripes, we are at a loss for a definitive designation. One of these sisters has typical bilateral macular degeneration with angioid stripes, a second sister has all of this in one eye and the macular degeneration but no stripes in the other eye, and the third sister has only slight macular changes.

Dr. Bedell, closing: Dr. Clay who has seen many angioid streaks said that in 63 recent cases 30 percent were associated with pseudoxanthoma elasticum. It is difficult for me to consider that the skin disease and the angioid streaks are anything more than coincidental changes.

He further reports that he has seen no streaks develop after the acute period has passed. You will recall that I showed how a streak developed and how it has continued to increase in both length and width.

I agree with Dr. Clay's observation that macular hemorrhages occur and that the end result of them is similar to disciform degeneration, but my interpretation is different. I consider the hemorrhages to be coincident with the angioid streaks and not part of the same disease, for I have seen hundreds of macular degenerations without streaks.

Dr. Zentmayer records the results of his careful observations of a patient for over 36 years. This is unique and worthy of critical examination, for the fundus changes were not only angioid streaks and choroidal-vessel sclerosis, but also hypertensive retinal disease.

Dr. Calhoun has made notable contributions to our knowledge of angioid streaks, especially in the field of familial vascular diseases, and if, eventually, the cause of the streaks is found to be a vascular degeneration, his contributions will rank high in the list of early investigations.

Dr. Verhoeff referred to his pathologic examinations, and it is satisfying to note that the changes in Bruch's membrane, ascribed by some as the cause of angioid streaks, were similar to and not more marked than he had often seen in senile eyes.

The drawings shown by Dr. Lloyd illustrated some of the confusing fundus changes.

It was gratifying to note the interest taken in the paper, and I thank those who have discussed it.

DIABETIC IRIDOPATHY*

C. A. CLAPP, M.D.
Baltimore, Maryland

Changes in the iris associated with diabetic conditions have been reported for many years. Some of these conditions are inflammatory whereas others are apparently not associated with inflammation. This latter group, I think, should be called iridopathy. Since they are apparently more frequent than the former and may even be confused with malignancy, I believe that a discussion of the changes and points in differential diagnosis may be helpful.

The noninflammatory changes in the iris were described by Parsons,[1] who stated that an extreme edema of the pigment layer of the iris with the formation of cystlike spaces occurred, as well as the freeing of pigment. Kamocki,[2] in 1887, found similar changes as illustrated in figure 1. It is evident that not only was the pigment epithelium of the iris edematous, with cystlike formations, but also there was an area of proliferation of the cells in the anterior capsule of the lens. Ball[3] also illustrated (fig. 2) the condition of edema and cystic formations in the pigment-epithelial layer and called attention to the occurrence of free pigment in the aqueous in cases of cataract extraction so that the aqueous appeared even black in color. Roemer and Foster[4] referred to the pigment layer as being swollen and the pigment often scattered over large spaces.

Zentmayer,[5] in 1913, reported a case of cataract extraction in a diabetic wherein a cast of the posterior pigmented surface came away. Duke-Elder[6] mentions softening of the posterior layer of the iris and an infiltration of the tissues with glycogen and rarely a lipemia. The infiltration of glycogen into the nerve fibers of the iris was demonstrated by Hoffman,[7] in 1914. Moore[8] found only one case of iritis in 62 cases of diabetes, but he states that marked changes in the epithelium of the posterior surface of the iris are almost constantly present and that thickening of the stroma may occur.

In 1935, Waite and Beetham[9] reported their findings in 2,002 diabetic patients and by comparison in 457 nondiabetic ones. They found evidences of depigmentation of the iris in 6 percent of the diabetics and in only 2 percent of the nondiabetics, with pigment deposits on the posterior surface of the cornea in 11.5 percent of the diabetics and in 5 percent of the nondiabetics, with about the same proportion of cases of pigment deposits on the anterior surface of the lens, 2.8 percent: 1.8 percent. The authors suggest that this disturbance of the pigment in the iris may be due to the storage of glycogen in the tissues.

Leopold,[10] in a recent article on ocular findings in diabetes which had been controlled for a period of 10 years, states that treatment had no effect on motility of ocular pigment and that iritis was not influenced by treatment. No case of rubeosis diabetica iridis was seen in the 100 cases reported. He also stated that depigmentation occurred in the older-age group of patients. In his last treatise on the eye, Tassman[11] states that the most frequent change is edema and swelling of the pigment epithelium with liberation of

*From the Wilmer Ophthalmological Institute of the Johns Hopkins Hospital and the Johns Hopkins University School of Medicine. Presented at the eightieth annual meeting of the American Ophthalmological Society, at Hot Springs, Virginia, June, 1944.

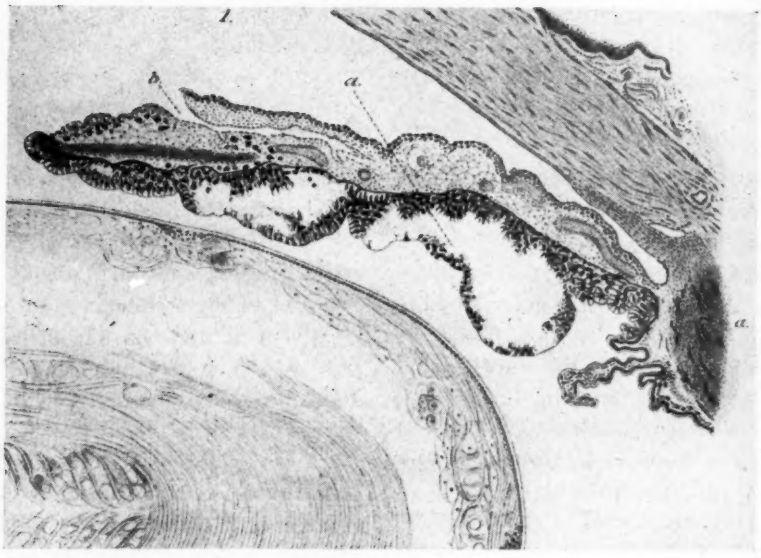

Fig. 1 (Clapp). Changes in the pigmented layer of the iris in diabetes (Kamocki[2]).

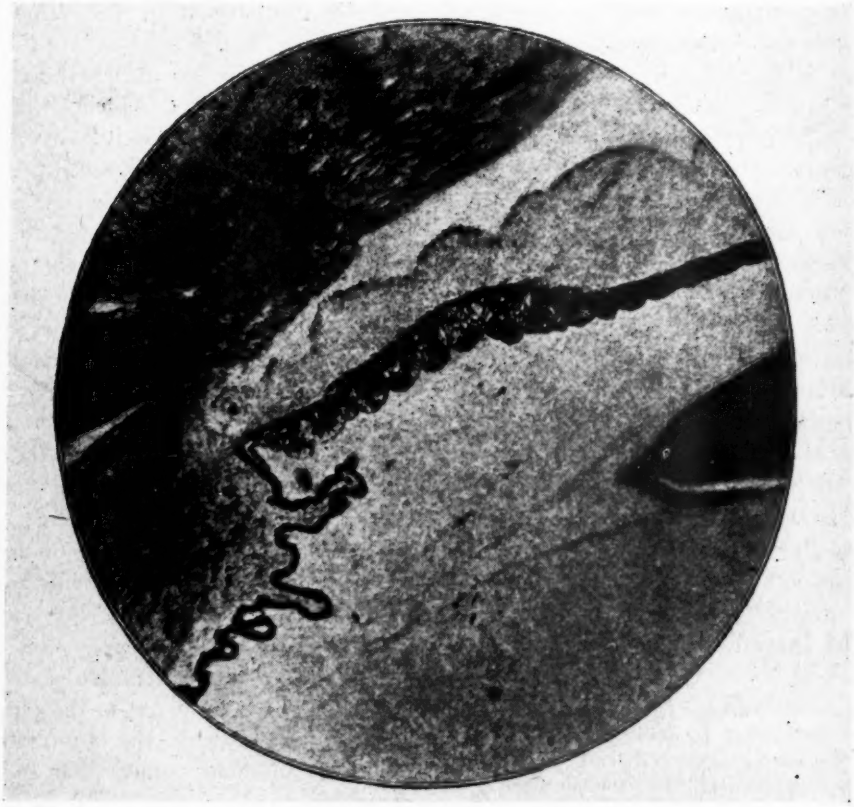

Fig. 2 (Clapp). Proliferated pigment epithelial layer with edema (Ball[3]).

free pigment. The stroma may become atrophic.

Villani,[12] in 1934, was able to demonstrate in experimental diabetes in animals, edema, thickening, and some vacuoles in the epithelial layer of the iris and ciliary body, but the changes seem more marked in the iris.

Practically all of the pathologic material in my hands available for study showed marked changes in the pigment-epithelial layer, but many of the eyes were removed because of a painful glaucoma so that it is difficult to evaluate as to whether the changes were all due to the diabetes or partially due to the secondary complications.

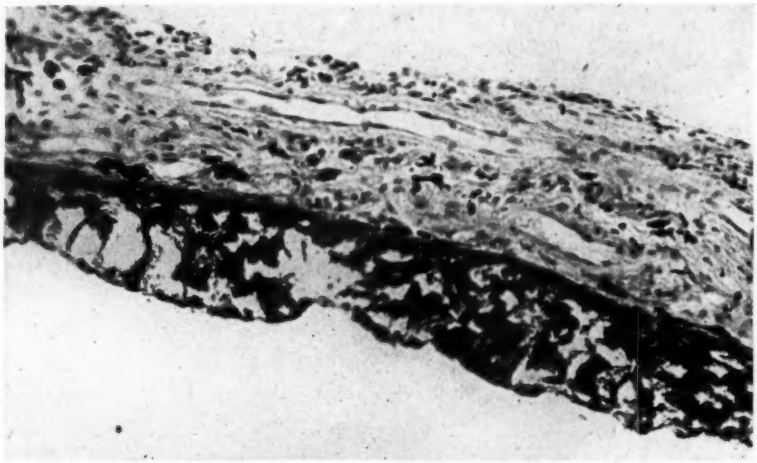

Fig. 3 (Clapp). Photomicrograph of the iris showing thickening of epithelial layer with large vacuoles in a white woman, aged 34 years, who had severe diabetes, with secondary glaucoma.

In figure 3 the section shows marked swelling, edema, and the presence of vacuoles in the pigment layer. There are also dilated vessels in the stroma suggesting iritis rubeola. This eye was removed from a young woman aged 34 years, and it was in a state of secondary glaucoma with a tension of 70 mm. Hg.

In figure 4, a photomicrograph of the iris in a white woman aged 66 years, with a history of diabetes for 20 years, there is again seen the thickening of the pigmented epithelial layer with numerous vacuoles present. This patient also had an acute attack of glaucoma with tension of 85 mm. Hg.

In the case represented by figure 5 is seen a marked thickening of the pigmented area with vacuoles, especially at the pupillary margin, but also some ectropion uveae. This patient also had glaucoma following occlusion of the central retinal vein.

Figure 6 is a photomicrograph of the iris of a doctor who showed iritis rubeola and later developed glaucoma. This section presents an apparent dissociation of the pigment epithelium and a migration of the retinal pigment, a considerable portion being deposited upon the anterior capsule of the lens and some apparently migrating into the stroma of the iris. It is difficult in a case of this kind to determine how much of the change should be attributed to iritis and how much if any to iridopathy.

In figure 7, fortunately, there is a section of a diabetic eye from a patient who did not have glaucoma but who died of

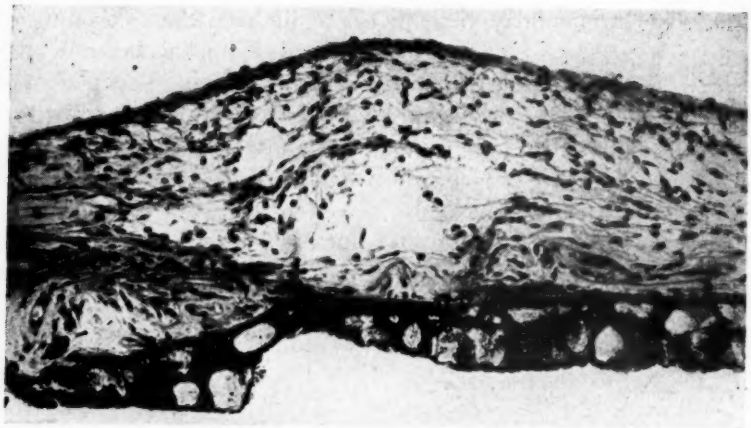

Fig. 4 (Clapp). Photomicrograph of an iris showing numerous vacuoles and thickening of epithelial layer. This patient also had increased ocular tension.

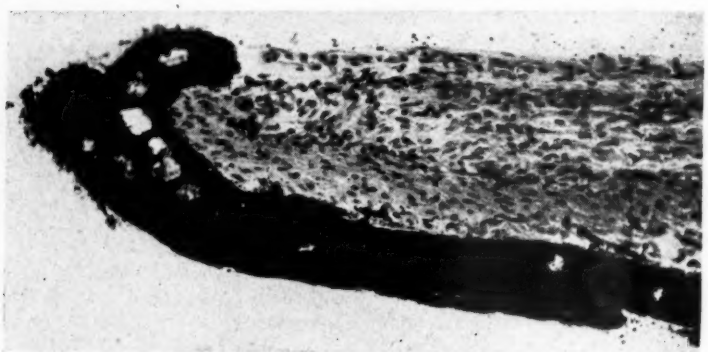

Fig. 5 (Clapp). Photomicrograph of the iris showing ectropion uveae with thickening and vacuole formation of the pigmented epithelial layer.

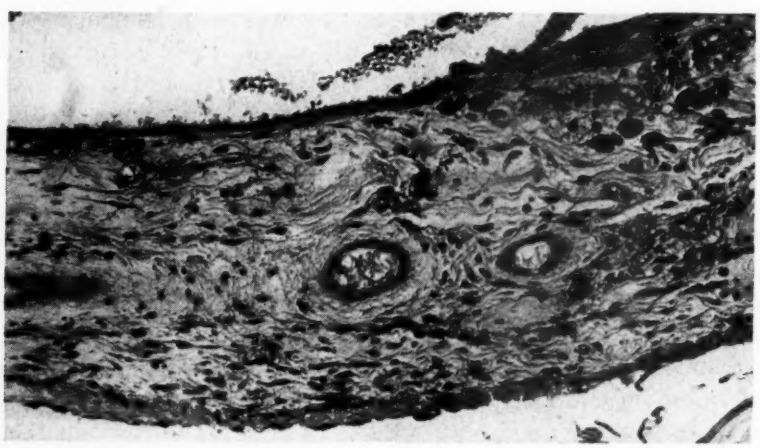

Fig. 6 (Clapp). Iritis rubeola, with new-formed vessels in iris, with dissociation of pigment-epithelial layer and migration of pigment.

pneumonia, so that these changes are apparently not secondary to glaucoma. Note here the marked thickness of the pigmented epithelial layer with the edema and vacuole-like formations. This represents, I believe, a rather typical change in the pigment layer in many cases of diabetes of several years' duration.

In view of these changes in edema, dissociation, and pigment migration as seen in the photomicrographs of the iris, I believe that one can explain the changes as seen in the following clinical cases.

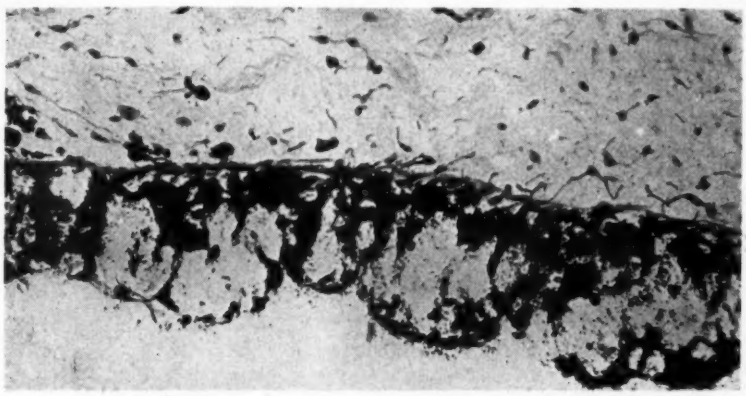

Fig. 7 (Clapp). Photomicrograph of a diabetic's iris, the patient having succumbed to pneumonia. The marked thickening with cystlike areas seems to be quite characteristic of the condition.

Case reports

Case 1. Mrs. K. W., aged 49 years, was first seen in May, 1942. She had been under treatment with insulin for 20 years and was probably the first United States citizen to receive this type of treatment. She was sent to Dr. Banting in October, 1922, and was at first informed that she would have to become a Canadian citizen before getting insulin. After a short time this requirement was waived, and she was treated by Dr. Banting and has been using the insulin ever since. Her eye history was that her vision was good except for near work, for which she used glasses. For two or three years she had noticed a change of color taking place in her left eye. She called the attention of her family doctor to the condition and he advised seeing an ophthalmologist. This she did, with disturbing results, for he gave the opinion that she had a malignant melanoma of the iris and advised immediate enucleation. She then consulted a second ophthalmologist, who diagnosed a melanoma but thought it was nonmalignant. Her consultation with me was made in order to secure another opinion.

The external examination showed the right eye to be normal in all respects, but ophthalmoscopically there was found a small hemorrhage near the macula. The left eye externally showed the pupil to be elliptical in form (see fig. 8), the long diameter being from the 2- to the 7-o'clock position 5 mm., whereas it was 4½ mm. in the opposite axis. The pupil reacted actively except down and in, where there was only a slight action. In this lower nasal quadrant was a dark pigmented area extending from the 6-o'clock up to the 9-o'clock position. The pupillary involvement did not include quite so large an arc as the periphery. At both the upper and lower margins was a definite thicken-

ing of the iris, whereas in the central area there was a definite atrophy with iris vessels showing in this region. A slight ectropion uveae was present at the lower margin of the pupil. Ophthalmoscopically there was a small round hemorrhage below the macula. In spite of the slight retinopathy, vision with correction was 20/16 in each eye.

Although there was thickening of the iris at the upper and lower margins of the pigmented area, I felt sure, in view of the atrophic condition in the central portion, that this could not be a malignant manifestation, and therefore advised continued observation. Subsequent examinations on May 14, 1942, and January, 1943, as seen by the transparencies, showed no change, so that I believe we were safe in assuming it was not a malignant growth nor even a precancerous condition.

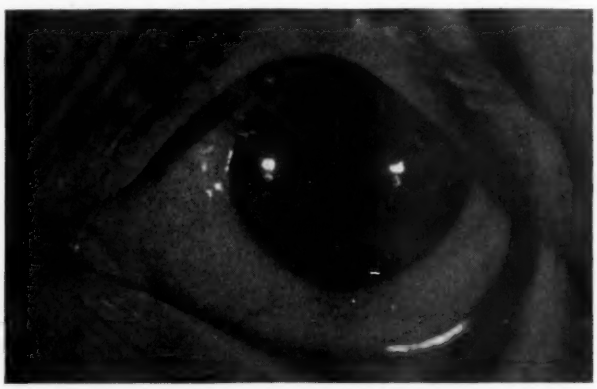

Fig. 8 (Clapp). A photograph of the left eye of a patient showing a melanotic area. The iris was thickened at the junction of the normal-colored iris and the melanotic portion. In the central area there was atrophy, with thinning and loss of mobility.

Case 2. E. F., a woman aged 55 years, was seen on July 25, 1942, with a history of having had diabetes for five years. Her complaint was failing vision. External examination showed both pupils reacting to light and accommodation, but the iris of the right eye also showed a pigmented area in the lower temporal quadrant. This area was small and did not have the atrophic center, but did have an elevated area at the temporal margin. This condition might even be a congenital heterochromia iridis, as neither the patient nor her family had ever noticed a change in the color of the iris. She had serious intraocular lesions in the form of a few lenticular opacities, right and left, and a large hemorrhage in the vitreous of the right eye, with a detachment of the retina. The fundus of the left eye showed marked vascular changes. Vision with correction was: O.D. 5/200; O.S. 20/70. This patient lived in the country and was not seen after the initial visit nor were communications answered, so that the final result cannot be reported.

Comments

If there occur pigment changes, whether due to toxic conditions or to diabetes, as Duke-Elder suggests, then the changes seen in Mrs. K. W. are explained. I have referred to statements and illustrations by Parsons, Kamocki, Ball, Roemer and Foster, Zentmayer, Duke-Elder, Leopold,

Foster Moore, Tassman, Hoffman, and Waite and Beetham, in which all seem to agree that the pigment layer often shows edema and the presence of vacuoles with some atrophy and depigmentation. What apparently takes place is that the pigment is liberated from the epithelial cells, on their death, and the stroma cells by a phagocytic action take up the freed pigment, thus causing the changes noted. Since this change is probably either metabolic or nutritional and not inflammatory, the term iridopathy would seem to be more appropriate than iritis, just as retinopathy is a better term than retinitis in a noninflammatory lesion. It is most important to keep this condition in mind and not be too hasty in advising immediate enucleation.

One may also speculate as to the cause of these changes in the pigment layer of the iris. They may be the result of foci of infection, which are known to be prevalent in cases of diabetes, but if so, why are not cases of focal infection other than the diabetic seen when these changes occur? If due primarily to the diabetes, what factor plays the role in producing the changes? While storage of glycogen in the cells may tend to liberate the pigment, no proof of this has been forthcoming. Possibly some yet undiscovered chemical may be the etiologic factor.

Conclusions

1. Iridopathy is a term to be used when changes in the iris occur that are of metabolic not inflammatory origin.

2. Diabetes may cause changes in the iris that may be confused with malignant melanoma.

3. Clinical and pathologic observations have apparently been confirmed by animal experimentation.

4. A further study of these changes is desirable, especially to ascertain whether they are limited chiefly to the diabetic, and also their possible cause.

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ONCHOCERCIASIS

A study of ocular complications in 342 African cases

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Since Robles (1916) first described eye changes in onchocerciasis, many observations have been recorded.

The purpose of this paper is to present the incidence of ocular complications in a series of cases examined in West Africa, and to discuss the cause of such complications. The paper is divided into four parts, as follows: I. Summary of the literature. II. Author's cases. III. Discussion and Summary. IV. Appendix A, Distribution of O. volvulus; Appendix B, Identification of microfilariae seen in aqueous (50 cases).

Part 1

Definition

Strong, the editor of "Stitt's tropical diseases." who has led expeditions in Liberia, in the Belgian Congo, and in Guatemala to study the disease, defines it thus:[88] "The term onchocerciasis implies a parasitic infection with the nematode Onchocerca volvulus, in which the most characteristic clinical manifestation is the occurrence of subcutaneous nodules or tumours.

"In certain individuals who apparently show special sensitiveness to the presence of parasites, to the action of their toxins, to products of metabolism, or to disintegration, secondary disturbances of the skin and eyes may occur."

Geographical distribution

Onchocerciasis is found in Africa and in America. In the latter it occurs in Guatemala and in Mexico. In Africa it has been reported in almost every colony in West and East Africa (*vide* Appendix A).

Brumpt[10] named the American worm Onchocerca caecutiens, but this is now taken to be synonymous with O. volvulus (Sandground[90]).

Mode of infection

The cycle of infection has been worked out by Blacklock[6] and by others.[4,8,26–28,35,39,90,96] During the day a female fly of the Simulium genus bites an infected human or animal (for example, eland or buffalo). The act of biting appears to attract microfilariae (M.f.) which are ingested by the Simulium. The M.f. undergo development while making their way from the stomach to the thoracic muscles and proboscis of the fly. The M.f. are now in a pre-adult stage and the fly, when biting the skin, is capable of infecting a new host. In the new host the worms grow to full-sized adult males and females. The female produces large numbers of motile M.f. which are found in the dermis, in the conjunctiva, and in other tissues of the eye, but not in the blood. A detailed description of the filariae and the M.f. is given by Strong.[88]

Results of infection

These are A, Nodules. B, Skin changes. C, Eye changes.

A. Nodules. When the adult worms have developed, several tend to become intertwined and encased in a nodule with a fibrous capsule. M.f. penetrate the fibrous capsule and escape to the dermis. Nodules are found in the subcutaneous tissues—95 percent on the trunk in Africa and 95 percent on the head in America. The nodules have been studied histo-

logically[5,10–12,48,53,67,88–91] and little inflammatory reaction is found. Low[48] suggests that encapsulation is nature's cure.

B. SKIN CHANGES are (a) Lichenification; (b) Itch or craw-craw; (c) Elephantiasis.

Robles described "erisipela de la costa," but other workers[6,24,25,40,41,60,61,–69,70,74–77,81] find a lichenification of the skin, particularly over the buttocks. This gives rise to an itch or craw-craw, which is believed to be a manifestation of allergy and not directly due to the presence of microfilariae. Elephantiasis has been found in some cases and hydrocele in others.

C. EYE CHANGES. Ocular complications were first described in Guatemala by Robles,[73,73a] Calderon,[14,15,] and Luna.[49–51] They described a characteristic form of punctate keratitis and iridocyclitis, and believed that removal of the nodules cured the ocular complications. Subsequent work has been done by many workers,[2,13,18,20,22,23,24,39,41,45,46,58.59.72] and in particular by Hissette[33–38] in Africa, Torroello,[92] and Silva[85,86] in Mexico, and by Strong[87–91] in Africa and America. The eye changes described are as follows: (a) Punctate keratitis; (b) vascular keratitis; (c) low-grade iridocyclitis; (d) choroiditis; (e) retrobulbar neuritis and optic atrophy; (f) visible microfilariae in the cornea, aqueous, and vitreous. Such changes rarely lead to blindness under 30 years of age, but there is considerable difference of opinion as to the frequency of such complications and as to their severity, as can be seen from the following table.

TABLE 1

INCIDENCE OF EYE CHANGES

Place	Author	Eye Changes percent	Blindness percent
Mexico	Larumbe	20	2.5
	Mühlens	10–20	—
Guatemala	Calderon	100	—
	Strong	5	—
	Mira, Diaz and Estevez	34.8	15
Belgian Congo	d'Hooghe	2.1	0.4
	Hissette in Sankuru	50	—
	in Lomani	50	—
	in Ilebo	43	10
	in Tangin Lonkala	51	27 (adults)
	in Katanga	50	20
	Strong		"most striking phenomenon"
Cameroons	Turner	—	1.04 Medical census
	Scott	30.3	Less than 0.3 –from all causes

In discussing blindness some authors stress the importance of keratitis, some indict occlusion of the pupil, and others name choroiditis or optic atrophy as the chief cause.

It is generally stated that nodules on the head are more likely to produce eye changes than are nodules elsewhere, but this is not supported by table 1, when it is remembered that head nodules occur in 5 percent of cases in Africa and in 95 percent in America. In recent years cases of ocular onchocerciasis have been reported in Europeans.[1,2,40,42,47,66,80]

Cause of ocular complications. Earlier workers agreed that the cause of ocular complications was a filarial toxin. After the discovery of (1) M.f. in all parts of enucleated blind eyes and of (2) M.f. in the cornea, aqueous, and vitreous of affected eyes by slitlamp examination, Mexican workers[86] claimed that the main cause was the presence of M.f. in the eye. Hissette[35] supported this view, stressing the importance of dead M.f., but recently Strong[88] stated that both factors were probably involved.

Treatment and Eradication. The ocular complications respond well to local treatment but eradication of the disease is not easy. As control of fly breeding is difficult, eradication of the disease is dependent on clearing human reservoirs of infection. Mass removal of nodules has been practiced in Mexico and in Guatemala with considerable success.[88] Other workers[22,44,64,81,84,90,92,94,98] have studied the effect of drugs, of which antimony and fouadin are the most promising.

Part 2

Author's cases

Three hundred and forty-two Cameroon soldiers were examined for nodules, for skin changes, for ocular complications, and some for microfilariae in the skin and in the blood.

With few exceptions the patients were under 30 years of age, and almost all were found to be infested with onchocerciasis.

A similar examination of 300 Gambian soldiers, in whom onchocerciasis is rare, served as a comparison.

The ocular complications in 38 hospital cases will also be mentioned.

Nodules

The firm, movable, subcutaneous nodules of Onchocerca volvulus vary in size from a small pea to a walnut, but there is a characteristic feel about them which experience quickly teaches. Nodules were found on 38.6 percent (standard deviation 2.8) of Cameroons and on 2 percent (s.d. 0.8) of Gambians. The diagnosis was confirmed by skin snip or by puncture of the nodule in 30 Cameroons and in 6 Gambians. The nodules varied from 1 to 5 in different cases, and were found under the skin in the following situations: Iliac crest, 44 percent; femoral trocanter, 39 percent; intercostal spaces, 16 percent; knee, 13 percent; elbow, 4 percent; head, 0; other sites, 4 percent. It should be noted that 83 percent of the nodules were around the hip and that none were on the head.

No nodules

It is recognized that a proportion of cases occur in which there are no nodules; for example, Strong found 5 percent, Blacklock 40 percent, and Sharp 45 percent nodule free.

The supposition that adult worms can lie free (as with O. gibsoni in cattle) has been proved by Van den Berghe[95] who found two such filariae at *post mortem*, thus corroborating an earlier report by Sharp.[83]

In this series, 124, or 38.6 percent, of the Cameroons had nodules and 218, or 61.4 percent, had no nodules. Fifty of the cases without nodules were examined by taking a skin snip from the right hip. M.f. were found in 49 of the 50 cases. It is assumed that this proportion is substantially correct for the remainder of the cases without nodules. For the purpose of this paper 100 percent infestation among the Cameroon cases is assumed.

In the 300 Gambians, 6, or 2 percent, had nodules and 294, or 98 percent, had no nodules. M.f. were found in a skin snip in 2 of 30 cases without nodules. For the purpose of this paper, the very

approximate figure of 5 percent is taken to indicate infestation among the Gambians. (Further work was done in examining 300 Nigerian soldiers, when it was found that 15 percent [s.d. 2] had nodules and that 15 out of 30 cases without nodules gave a positive skin snip.)

Skin changes

Lichenification, or dry scaly skin over the buttocks, was noted in 1 percent of the Gambians, and in 5 percent of the Cameroons. Only a few complained of itch, although many had had it in the past.

No figures were kept, but a number of Cameroons had a thickening of the scrotum which suggested early elephantiasis rather than the change seen in avitaminosis.[62] Wuchereria bancrofti (the usual cause of elephantiasis) is very rare in the Cameroons (Appx. B). Hydrocele was seen in three cases.

Ocular complications

Three hundred and forty-three Cameroon patients and 100 Gambians were examined by slitlamp microscope (×20) and by ophthalmoscope, their pupils having been dilated. The findings in the Cameroon cases and in 38 hospital cases are grouped under the following headings:

(1) Microfilariae
  (a) in the cornea
  (b) in the anterior chamber
  (c) in the lens
  (d) in the vitreous
(2) Punctate keratitis
(3) Iridocyclitis
(4) Chorioretinitis
(5) Optic neuritis

Microfilariae

a. *In the cornea.* In only a few cases was there evidence of microfilariae in the cornea. In these few cases an immobile white line probably represented a dead M.f. Only one live M.f. was seen in the cornea, whence it disappeared in 24 hours, leaving no reaction.

b. *In the anterior chamber.* In the anterior chamber M.f. were common. By slitlamp 31, or 9 percent, of the Cameroons had unmistakable, easily seen, live M.f. constantly lashing, wriggling, tying and untying themselves in the aqueous. M.f. could also be seen with the binocular loupe. No patient complained of entoptic disturbance.

The M.f. moved around with the aqueous circulation and were unaffected by the beam of light. An average circuit took 60 seconds. A single M.f. often dropped out of sight after two or three circuits. When many M.f. were present, the circulation was noticeably slower and individual M.f. could be seen in the same position for 30, or more, seconds at a time. There was no evidence of phototaxis.

M.f. were more common in the eyes of patients with nodules than in those without nodules. The number seen varied from 1 to 50 in different cases, but 2 or 3 were the average.

In cases with few M.f. the numbers altered in an irregular fashion from hour to hour.

One patient examined 3-hourly during the day and 6-hourly at night for 36 hours gave the following numbers of M.f. in the aqueous:

R.	2.	1.	2.	1.	4.	1.	1.	3.	3.	0.	2.	1.	4.
L.	0.	1.	0.	0.	1.	1.	0.	2.	2.	2.	0.	1.	1.

The same patient was seen six times at monthly intervals and 2 or 3 M.f. could always be found.

Cases in which there were larger numbers—for example, over 10—showed greater variation. In one case M.f. were too numerous to count one day. An estimate of 70 in one eye and 50 in the other

was made. The following day, the numbers were 12 and 15, respectively. No dead M.f. were ever seen in the aqueous. Three cases in which there were many M.f. were examined at frequent intervals over a period of six months, and no diurnal or lunar influence was noted.

Despite the irregular variation in numbers, it is felt that the presence and numbers of M.f. in the aqueous could serve as a guide to the success of any attempt to eradicate the disease. (Knowledge of the longevity of M.f. would supplement the usefulness of this test.)

c. *In the lens.* In two cases, one end of a M.f. had become engaged in the anterior capsule. In one case seen daily the M.f. died after 24 days, but the other was still alive after 2 months. The dead one was clearly visible four months later, but was barely visible after eight months. In neither case was there any reaction in the eye or in the lens.

d. *In the vitreous.* Microfilariae were found to be uncommon in the vitreous, the slitlamp and the +40-lens method of Estrada[23] being used.

The indentification of M.f. is described in Appendix B. All were found to be M.f. O. vulvulus.

Punctate keratitis

It was seen in the hospital cases that the first corneal change was a small circular opacity, composed of numerous fine yellow dots, at any level in the substantia propria, accompanied by photophobia and conjunctival hyperemia. Such opacities might fade away or enlarge. If they enlarged, the yellow color turned to gray or white, and these gray nebulae, which grew sometimes to be 0.5 or 1.0 mm. in diameter, were a common corneal finding. They were found equally in all areas of the cornea. Similar gray nebulae have been noted in trachoma, and rarely in other forms of keratitis. Lesions of the corneal epithelium were not included. No case of vascularization of the cornea was seen except in trachoma and in pterygium, which are not uncommon.

The following table compares the incidence of onchocerciasis with punctate keratitis:

	100 Gambians percent	*342 Cameroons* percent
Onchocerciasis	5.0	100.0
Punctate keratitis	5.0	25.7

Allowing for the fact that 10 percent of Gambians and 2 percent of Cameroons have trachoma (which may account for some of the corneal lesions), it is seen that punctate keratitis increases directly with, and is presumably caused by, onchocercal infestation.

In the few cases when corneal M.f. were seen, they were not in or near the nebulae, although Hissette considers that the nebulae or puncta are local reactions to dead M.f. Follow-up of such cases did not show the development of puncta round the M.f.

Thirty-one of 342 Cameroons had M.f. in the aqueous; 16 of these had no eye changes other than the presence of M.f. In some of the 15 cases with eye changes, the nebulae were only in one eye and not always in the eye presenting the M.f. In none of the 31 cases was the eye inflamed. It is concluded that punctate keratitis is not directly caused by the presence of M.f. in the cornea or in the aqueous.

Punctate keratitis was as common in Cameroons without nodules as in cases with nodules. (It was this unexpected finding which led to the investigation of skin snips in cases without nodules, when it was found that many cases without palpable nodules are infected.)

Iridocyclitis

A deposit of fine dots of pigment on the posterior corneal surface was found in 27, or 7.9 percent, of Cameroons, all

of whom had punctate keratitis. It was seen to develop in hospital cases accompanied by photophobia, lacrimation, and ciliary flush. The pigment had a remarkable tendency to clear, leaving only one or two isolated spots. The pigment K.P. had no resemblance to "Mutton-fat drops." Synechiae or irregular pupils were rare. The combination of deep nebulae and pigment K.P. is very suggestive of onchocerciasis.

Chorioretinitis

In no case in the series was there evidence of chorioretinitis, and only one hospital patient, who also had syphilis, had choroiditis.

Optic neuritis

Vision in the 342 Cameroons was very good. Ninety-six percent had vision of 6/6 or better, in each eye. None of the remaining 4 percent had choroiditis or optic atrophy, and in less than 1 percent was the impairment of vision related to onchocercal changes.

However, retrobulbar neuritis was not uncommon among the hospital cases and two cases of optic atrophy were seen. These cases are described in the following section:

HOSPITAL CASES

Thirty-eight cases of ocular onchocerciasis were admitted to hospital. The majority of these patients were Cameroons, but Gambians, Gold Coast, and Nigerians were also treated. The presenting signs were as follows: Keratitis, 9; iridocyclitis, 10; retrobulbar neuritis, 6; optic atrophy, 2.

The remainder were admitted for investigation and had no complaint. Keratitis and iridocyclitis were frequently associated. The findings in the 38 patients, all of whom had M.f. in the skin, were as follows: Nebulae, 36 (including 10 yellow nebulae); M.f. in cornea, 5; Pigment K.P., 23; M.f. in the aqueous, 22; Nodules in the skin, 12.

Punctate keratitis and iridocyclitis have already been described and respond well to local treatment with heat and atropine. Although heat had a tendency to increase the number of M.f. in the anterior chamber, no adverse effect resulted.

Retrobulbar neuritis

In the six cases of unilateral retrobulbar neuritis, the onset was sudden. No sign of avitaminosis was noted. In four cases, complete recovery took place in three weeks. In the fifth case papilledema developed a few days later. In this case, recovery was delayed for two months, and although vision returned to 6/5, a relative pallor of the disc was noted eight months later when vision was 6/6. In the sixth case, no recovery of vision took place in two months, but in three months, vision improved from 4/60 to 6/24.

In all cases, the onset was associated with slight pain, lacrimation, and a mild ciliary flush. In three cases there was an associated edema of the upper eyelid, with some proptosis in two cases which have been fully described elsewhere.[79] It was concluded that the cause was an anaphylactic edema of the orbit and nerve due to the toxins of an adult worm.

Optic atrophy

One case of optic atrophy occurred in a Cameroon soldier aged 23 years. He had enjoyed good health and good sight until six months before his admission to hospital with hydrocele.

He mentioned his failing sight after operation. Bilateral optic atrophy was found with vision of 6/18 R. and L. No other eye change was noted. Kahn, C.S.F., X-ray, and general examination showed no abnormality. He had not had any course of injections (for example,

arsenic). He knew of no other case in his family. No nodules were palpable, but M.f. (O. volvulus) were found in skin snip. As M.f. are found in nearly all Cameroon skins, great importance cannot be attached to this finding.

The other patient, aged 29 years, gave a similar history. Kahn, C.S.F., X-ray, and general examination showed no abnormality. Each eye had one corneal nebula, and both discs were atrophic, with no other fundus change. Vision was R.E. 3/60, L.E. 6/36. He had O. volvulus nodules over the left hip. In the absence of any other discoverable cause, onchocerciasis must be considered.

Treatment

The eye conditions responded well to local treatment.

The average stay in hospital was three weeks. Various measures were tried to eradicate the disease. In cases presenting M.f. in the anterior chamber, the number counted one and four months after treatment was taken as a guide to the result.

(1) Excision of all nodules—3 cases. No improvement resulted.

(2) Course of 16 intramuscular injections of Stibophen, 5 c.c.—1 case. Slight improvement resulted.

(3) Course of 10 intravenous injections of Novarseno benzol 0.6 gm.—2 cases. No improvement resulted.

(4) Course of 5 intravenous injections of 10 c.c. 1-percent methylene blue—2 cases. No improvement resulted.

(5) Atropine and cocaine had no effect on the movements or numbers of microfilariae in the aqueous.

Part III

Discussion

Cause of complications

In the definition of Onchocerciasis, the following were given as causes of skin and eye disturbances in certain sensitive individuals: 1. Presence of parasites. 2. Products of disintegration. 3. Action of toxins. 4. Products of metabolism.

Each cause must be considered first in respect of filariae and secondly in respect of microfilariae.

Filariae

Cause 1. Presence of parasites. The parasites are well tolerated by the host. Encapsulation of worms may be a reaction to irritation, but histologic studies of nodules show little inflammation in the subcutaneous tissues. As the filariae are very rarely found in the eye, one concludes that the presence of filariae is not a cause of eye changes. (Wilson[97] and Silva[86] have both reported an unconfirmed case of a filaria in the eye.)

Cause 2. Products of disintegration are not a cause, for no eye changes have been reported following injection and destruction of nodules on a large scale.[20,59]

Causes 3 and 4. Action of toxins and products of metabolism. These will be considered together under the heading of "toxic causes." It follows that if neither the presence nor the disintegration of filariae causes a reaction, the eye changes are most probably due to a toxin, whether it be a product of metabolism or a secretion.

Microfilariae

Cause 1. Presence of parasites. M.f. are present both in the dermis and sometimes in the eye. Their presence is well borne, as has been seen in previous paragraphs, when M.f. in the cornea, in the aqueous, and in the lens have been described in eyes free from inflammation for many months. Furthermore, inflamed eyes become quiet despite the presence of M.f. It is concluded that the presence of M.f. in the eye is not a cause of ocular complications.

Cause 2. Products of disintegration are unlikely to be a cause in view of the lack of reaction when one M.f. in the lens was seen to die and later to be absorbed; in view of the lack of reaction around dead M.f. in the cornea; and in view of the absence of dead M.f. in the aqueous in inflamed eyes. This is supported by Torroella's[92] experiment of killing M.f. by the injection of 1:1,000 plasmochin into the aqueous without reaction.

Causes 3 and 4. Toxic causes. The action of microfilarial toxins is difficult to assess. One might conclude that microfilarial toxin is not a potent cause as M.f. are so well borne in the eye, but one must also consider the thousands of M.f. in the dermis, each of which may add toxin to the circulation.

The possibility that each M.f. may produce a trace of toxin is difficult to exclude. It has been noted that in cases with M.f. in the eye a greater proportion than average have corneal changes, that in inflamed eyes there is a higher proportion showing M.f. than the average, and that the aqueous circulation is slower in cases with numerous M.f.

Further work requires to be done to establish the significance of these points. Meanwhile two conclusions are drawn: (1) That the cause of the eye changes is a toxin (probably filarial, possibly also microfilarial); (2) that, as microfilariae are produced by filariae, the primary source of the toxin is the adult worm.

Treatment and Eradication

It follows from the last conclusion that, apart from local treatment of the eye, the aim is to remove or destroy filariae. It has been shown that many cases occur without palpable nodules and it is assumed that nonencapsulated worms are present in such cases.

There is no reason to suppose that nonencapsulated worms may not also be present in cases with nodules, which would explain why, in the absence of reinfection, fresh cysts appeared 1½ years after the removal of nodules.[86] It follows that the attack must be directed to destroying the nonencapsulated adult Onchocerca volvulus and that research must be directed to the discovery of a drug that will achieve this purpose.

The common occurrence of nonencapsulated filariae will not be proved until the work of Van den Berghe[95] has been repeatedly confirmed, and it is suggested that the subcutaneous tissue around the ilium is a favorable site to search for unencapsulated Onchocerca volvulus at *post mortem* in West Africa, and around the head in America.

Speculation

In an area where Simuliidae carry infection, babies do not escape being bitten and infected. The pre-adult worms may take some months or even years to mature, but then one expects them to produce M.f. As nodules are stated to be uncommon in children, one anticipates that the nonencapsulated filariae are proportionately common. Proof of this would be the common finding of M.f. in skin snips from children without nodules in an infected area.

Summary and Conclusions

1. The ocular complications found in 342 Cameroon soldiers (in whom 100-percent infestation with onchocerciasis was assumed) were as follows:

	Cases	Percent
(a) Punctate keratitis	61	17.8*
(b) Punctate keratitis with iridocyclitis	27	7.9*
(c) M.f. (microfilariae) in the aqueous of otherwise unaffected eyes	16	4.6
Total	104	30.3

* 15 also had M.f. in the aqueous

2. Further complications were found in 38 hospital cases:

(a) Retrobulbar neuritis .....rare
(b) Optic atrophy .....very rare
(c) Choroiditis .....exceptional

3. M.f. O. volvulus was the most common (if not the only) M.f. to enter the anterior chamber. Its presence was well tolerated.

4. The cause of complications was a toxin (probably filarial, possibly microfilarial).

5. The common occurrence of nonencapsulated filariae (O. volvulus) is postulated.

Part IV

Appendix A

Onchocerciasis has been reported in the following places. The approximate rates of infection are given where available.

West Africa Place	*Author*	*Percentage*
Senegal	Clapier	
	Montpellier and Lacroix	
Gambia	Scott	5
French Guinea	Laigret	
	Clapier	11
French Sudan	Laigret	5
Sierra Leone	Blacklock	45
Liberia	Strong	
Ivory Coast	Laigret	
	Joyeux, Sedan and Esmenard	
Gold Coast	Corson	6
	Macfie and Corson	34
Dahomey, French Niger	Montpellier and Lacroix	
Nigeria	Sharp	55
	Best	
	Scott	50
Carmeroons	Fulleborn	
	Sharp	95
	Scott	98
French Equatorial Africa	Ouzilleau	
	Ouzilleau et al.	
Belgian Congo	Brumpt	50
	Rodhain	50
	Rodhain et al.	50–60
	Dubois	60
	Hissette	73
	Strong, Hissette et al.	100
	Blanchard and Laigret	
	d'Hooghe	88
	l'Ouelle	5
	Rafai	50
	Applemans	

East Africa	*Author*	*Percentage*
East Africa		
Sudan	Bryant	
	Cruickshank	9
Uganda	Gibbins and Loewenthal	54
Kenya	Preston	
	Harley-Mason	
	McMahon	51
	Harris	
	Hawking	
Tanganyika	Gibbins	
	Enzer	
Nyasaland	Gopsill	
North Rhodesia	Strong	

America

Strong[88,90] has published a comprehensive survey and bibliography of work in Mexico and in Guatemala, to which can be added recent papers by Estrada[23] and by Quevedo.[72]

The incidence in affected parts of Guatemala is around 40 percent (Calderon 38 percent; Strong 40 to 66 percent; Mira 30 percent).

Appendix B

All previous reports of M.f. in the eye are of M.f. Onchocerca volvulus with the exception of the two following:

1. Boase[9] reported a case with M.f. in the aqueous and with M.f. A. perstans in the blood. No skin snip was taken, so the identity of the M.f. in the aqueous remains uncertain.

2. McMullen[56] reported a case with M.f. in the aqueous, with M.f. bancrofti in the blood, and with negative skin snip. He concluded that the M.f. in the aqueous were M.f. bancrofti but, in subsequent discussion, Manson-Bahr[52] was not convinced.

Identification of microfilariae in the eye

The following experiments were carried out to identify the M.f. seen in the anterior chamber:

1. Thick blood films were taken at

midday and at midnight from 100 Gambians and from 100 Cameroons. The following table summarizes the results:

	M.f. A. perstans	*M.f. bancrofti*	*M.f. loa loa*	*No M.f.*
100 Cameroons	42 (s.d. 5.)	Nil.	26 (s.d. 4.5)	32 (s.d. 4.7)
100 Gambians	28 (s.d. 4.5)	31 (s.d. 4.7)	Nil.	41 (s.d. 5.)

Only one loa appeared in a night film, but scanty bancrofti were found not uncommonly in day films. Their periodicity and careful examination differentiated them from loa loa. Some of the patients had a mixed infection of A. perstans with either loa or bancrofti.

2. Thirty Gambians with M.f. bancrofti in the blood were examined at midnight. Only one had M.f. in the aqueous and he was found to have M.f. O. volvulus in the skin. It is concluded that M.f. bancrofti rarely, if ever, enter the anterior chamber.

3. Thirty patients with heavy infection of A. perstans in the blood had no M.f. in the anterior chamber. It is concluded that M.f. A. perstans rarely, if ever, enter the anterior chamber.

4. Of 30 patients with M.f. loa loa in the blood, 4 had M.f. in the aqueous, but the 30 cases also had M.f. O. volvulus in the skin. Three patients were selected with M.f. in the eye and with heavy infection of loa in the blood. M.f. were withdrawn from the aqueous and in each case found to be M.f. O. volvulus. Furthermore, two patients with an adult Loa loa under the conjunctiva showed no M.f. at the time in the eye. It is concluded that M.f. loa loa seldom, if ever, enter the anterior chamber.

5. Including hospital patients, 50 cases were seen with M.f. in the anterior chamber. In every case M.f. O. volvulus were demonstrable in the skin. In six cases M.f. were withdrawn from the aqueous and found to be M.f. O. volvulus. It is concluded that the most common M.f. to enter the eye is M.f. O. volvulus, and that there is presumptive evidence that M.f. in the aqueous are M.f. O. volvulus unless proved to the contrary.

6. It is not easy to identify a single M.f. withdrawn from the aqueous—for example: (1) The sheath of M.f. loa loa or bancrofti seldom is visible in a stained preparation; (2) as the nuclei of O. volvulus do not reach to the tip, an understained M.f. O. volvulus may give the impression of sheathing. The following routine was therefore adopted:

After withdrawal, the aqueous was examined under low power without a cover slip. Any moving M.f. were easily spotted. They were kept under observation and, as the lashings slowed down, it was found that M.f. O. volvulus executed a characteristic brisk bowing movement, making its head and tail meet, repeating this to the same side, and tending to straighten out before death. No sheath was present.

M.f. loa loa and bancrofti (transferred from blood to saline) undulated slowly from side to side as their lashing slowed down. At death, and when movements were slow, there was no difficulty in seeing the sheath. (By varying the strength of saline, M.f. loa loa could be made to shrink inside its sheath.)

A. perstans is smaller than O. volvulus, so that by measurement, by the absence of sheath, and by the characteristic postures before death, a diagnosis of M.f. O. volvulus can be made in the unstained preparation. When the preparation is dried, fixed, and stained, the diagnosis is confirmed.

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NOTES, CASES, INSTRUMENTS

RECURRENCE OF TOBACCO-ALCOHOL AMBLYOPIA*

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Recurrence of tobacco-alcohol amblyopia is uncommon but there are some cases on record. deSchweinitz[1] mentioned relapses in several patients with this condition who resumed smoking. Nettleship,[2] Berry,[3] and Shears[4] also described recurrences, and I have seen a few such cases. The purpose of this paper is to report a case which, I think, is of some significance in considering the etiology and treatment of this condition.

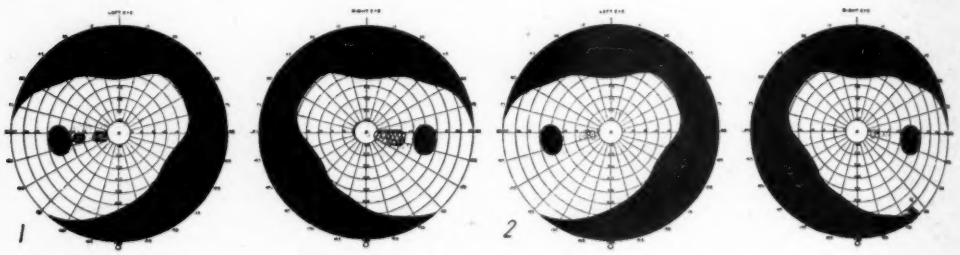

Fig. 1 (Carroll). Visual fields before treatment. Dotted area = 3 mm. red; oblique lines = 1 mm. white; cross-hatched area = 5 mm. red. Vision, R.E. 20/50; L.E. 20/40. Central fields taken at 1 meter.

Fig. 2 (Carroll). Visual fields after treatment. Dotted area = 3 mm. white. Less bright in this area; no definite scotoma. Vision O.U., 20/20—.

During the past eight years certain of these patients have been hospitalized and allowed to continue their usual intake of tobacco and alcohol while under careful observation.[5] When this study was first started the patients were given powdered brewer's yeast in large quantities and a well-balanced diet, adequate in all respects. Since the results were good, vitamin-B complex was substituted for the yeast; next, a group was given a poor diet supplemented with vitamin-B complex. Finally, a group was placed on a diet inadequate in all known vitamins, allowed to drink and smoke the usual amount and given just synthetic vitamin B_1. It seemed reasonable to assume that any improvement in this group could probably be attributed to the vitamin B_1. The patient whose report follows was from this group.

D. W., a colored woman aged 31 years, was admitted to the Institute of Ophthalmology on March 23, 1942. Her vision with or without correction was the same, namely, 20/50 in the right eye, 20/40 in the left. The visual fields (fig. 1) showed centrocaecal scotomas, and the rest of the ocular examination, including the appearance of the optic discs, was entirely negative. Medical examination revealed an enlarged liver, but all other examinations gave normal results. Questioning of the patient and her family indicated that she had been drinking 1 pint of liquor and smoking 1 to 2 packages of cigarettes daily for several years. Our dietitian took a careful dietary history, and from this

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we were able to calculate the following data: the daily caloric intake was slightly over 2,500 calories, which was adequate to maintain the patient's weight and prevent her from appearing malnourished. But about half of the calories came from the consumption of liquor. Knowing what foods she did eat we could estimate the total amount of vitamin B_1 taken each day. And from this we found that she was receiving an inadequate amount of vitamin B for the number of calories consumed (Table 1).

TABLE 1
RATIO OF CALORIES TO REQUIRED VITAMIN INTAKE

Calories from food	1,293
Calories from liquor	1,250
Total calories	2,543

For 2,543 calories	
Minimum daily thiamin requirements	661 micrograms
Actual thiamin intake	501 micrograms
Daily deficiency	160 micrograms

In the Hospital the patient was placed on a diet *inadequate* in all known vitamins. She received slightly more than 1 pint of liquor daily and smoked her usual amount. But 40 mg. of thiamin by mouth and 20 mg. by vein were administered daily. She continued on this regimen for 23 days, and at the end of that time her vision was 20/30 in each eye and the scotomas were considerably smaller. She was discharged from the Hospital and given 100 10-mg. tablets of thiamin to use at home—1 tablet twice a day.

On leaving the Hospital she returned immediately to the same environment where she had developed this so-called toxic amblyopia. She did the same things, consumed the same amount of alcohol and tobacco, ate the same food. Everything was the same except that she took 2 10-mg. tablets of thiamin daily. During the next three months she was seen frequently in the clinic. The vision became 20/20 in each eye and it was not possible to plot any scotomas (fig. 2).

Then the patient disappeared; she did not respond to letters from the Social Service Department, and we could not locate her again until four months later, when she returned to the Eye Clinic because of recurrence of poor vision. She stated that she had continued to take the thiamin until four weeks previously, that two weeks after that the vision seemed slightly impaired and became progressively worse. Vision now was reduced to 15/200 in the right eye, 20/50 in the left; the visual fields (fig. 3) showed large centrocaecal scotomas, especially in the right eye, and there was observed for the first time temporal pallor in the right disc. She complained of itching of the skin and

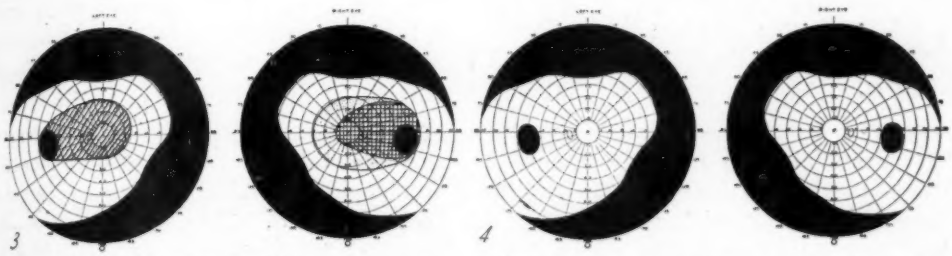

Fig. 3 (Carroll). Visual fields on November 12, 1942. Dotted area = 3 mm. red; oblique lines = 1 mm. white; cross-hatched = 3 mm. white. Vision, R.E. 15/200; L.E. 20/50 −1.
Fig. 4 (Carroll). Visual fields on February 11, 1943. Dotted area = 3 mm. red. Vision O.U., 20/20.

weakness of the legs. She was moody and irritable.

On admission to the Hospital she was again placed on the same regimen as during the previous hospital stay. X-ray examination of the small intestine disclosed —and I quote from the X-ray report of Dr. Ross Golden—"A definite disturbance in the physiology of the small intestine which we have come to call the deficiency pattern or irritation pattern."

After 10 days the vision of the patient had improved to 20/50 in the right eye, 20/40— in the left, and she was discharged. In a few weeks vision increased to 20/30 in each eye, and the scotomas became very small. At this time she was given vitamin-B complex and was given instructions regarding a well-balanced diet. She was strongly advised to discontinue drinking, but the advice had been given to her by others for several years without effect. Efforts were now made by a psychiatrist and social workers to readjust the individual, and she was followed up to May, 1943. Her vision was then 20/20 in each eye (fig. 4). She continued to drink, as so many of these patients do, despite any advice to the contrary.

Eight months later the patient died from "meningitis" at home. No autopsy was performed. Her family stated that her vision remained good up to the time of death.

There is one point I wish to make in regard to the treatment. For investigational purposes the use of just synthetic vitamin B_1—that is, thiamin—seems justified. It is of some scientific value, I think, to know that in this and several other cases vision returned almost to normal, apparently due to the use of just this one small fraction of the whole vitamin-B complex. But deficiency diseases tend to be multiple. A pure thiamin deficiency is considered rare by nutrition authorities. If patients take a diet low in vitamin B_1 it is usually at least somewhat low in many of the other components. Therefore, in practical therapeutics—in office and clinic practice—the administration of B complex is much to be preferred; it can be supplemented by B_1 if desired. In a well-balanced diet, adequate in all respects, there are doubtless many factors that the research biochemists have not yet discovered. There is still no perfect substitute for a good diet, and all these patients, I think, should receive instructions regarding a good diet. Previously, in patients suffering from tobacco-alcohol amblyopia who failed to decrease or stop their intake of these substances, there was little hope of improvement in vision. Now we have a method of restoring the central vision to many of these patients, even if they refuse to abstain, and I think a fair number of them today have good vision who otherwise would have remained industrially blind. Some of these people who were formerly unemployable now do fine precision work in war industries.

Summary

This is a report of a woman with tobacco-alcohol amblyopia who regained normal vision and normal fields, although she did not decrease her alcoholic intake nor improve her diet. Vitamin B appeared to be the factor responsible for the satisfactory result. When the thiamin was discontinued the amblyopia recurred, and when it was used again essentially normal vision was obtained. However, it appears advisable in office and clinic practice to use a good diet supplemented by the whole vitamin-B complex as well as just vitamin B_1 for the best results in the treatment of this condition.

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VISUAL DISTURBANCE AFTER INGESTION OF DIGITALIS

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The first use of digitalis in medicine seems to have been made by William Withering and described by him in 1785. In his description he states that when given in large doses it may cause vomiting, giddiness, and a confusion of vision so that objects appear green or yellow, and he cites three cases of visual disturbance of this type. It seems doubtful that the knowledge of this visual disturbance resulting from the use of digitalis is very widespread in the medical profession among those practicing either internal medicine or ophthalmology. In the Journal of the American Medical Association for 1925 (page 716), Sprague, White, and Kellog have an excellent review of the subject up to that time. Their study was prompted by a report of a case by Henry Jackson in December, 1924, at a meeting of the Suffolk Medical Society of Boston. They were unable to find any reference in English indicating any original work on visual disturbances from digitalis at that time, but of such references there were several in the pharmacologic and toxicologic literature. The reason for this is that most of the cases have been due to a frank poisoning by the drug. The American Encyclopedia of Ophthalmology states that visual disturbance from digitalis is a rare occurrence, and in 1885 de Schweinitz quoted but one case. In French and German literature such cases have been reported by Purkinje, Tardieu, Köppe, Martin, Boucheron, Focke, Lewin and Guillery, Kobert, and Uhthoff. The visual disturbance seems to be variable but the most striking characteristic is chromatopsia, objects seeming to have a green or yellow hue. In a few instances red was the color resulting and in other cases objects, especially white objects and flames of fire, appeared blue, and cases have been reported in which objects seemed to be covered by snow or frost.

The first of the patients in the series of four cases reported here complained of this phenomenon and at the time it was not recognized as being due to digitalis, but was believed to be the result of retinal edema and hemorrhages. Scotomas have also been observed, and a relative central scotoma was present in case 4 of this series.

Those desiring to study in detail these conditions, are referred to the article in the American Medical Journal which has been mentioned as the writers there have made a very complete review of the literature up to 1925 and have added seven cases of their own observations.

CASE REPORTS

Case 1. Mr. K. H. R. was first seen in January, 1918, when his age was 32 years, for the correction of an error of refraction. In 1924 he suffered a cardiorenal breakdown as the result of alcoholism. Dr. Alfred Stengel treated him in the University Hospital, where, on September 19, 1942, the ocular fundi were examined by the writer. The discs were hyperemic, with blurring of the margins; there were marked accentuation of the arterial reflex and indentation of the un-

derlying veins, with hemorrhages at both maculas, reducing the vision to: O.D. 5/20; O.S. 5/30. On October 10th, there was an occlusion of the inferior retinal artery, with a corresponding loss of the upper visual field. About this time the patient saw everything apparently covered with snow or frost, an illusion believed due to the retinal condition. He was taking only moderate doses of digitalis. He was discharged early in January, 1925, with vision of 5/5 partly in each eye and went on to a complete recovery of vision both central and peripheral. He died after a coronary thrombosis in 1942. It was not realized until recently that his sensation of the frosting on objects was possibly due to digitalis.

Case 2. Mr. F. M. P. was first seen in October, 1924, with incipient lens changes but a corrected vision of 5/5+ in each eye. At that time he had retinal changes with increased arterial reflex and indented veins. In 1937, his cardiac condition became bad and digitalis was given him in rather large doses. After two months of this condition he noticed that all light objects were colored blue, such as white flowers, papers. The digitalis was stopped, and the chromatopsia disappeared within a week. Later administration of smaller doses did not bring a return of the colored vision.

Case 3. Mr. M. W. B. was first seen in 1920, when he was aged 46 years, for refraction. In September, 1931, the retinal arteries showed signs of sclerotic changes and these have gradually increased. In 1942, he developed a cardiac condition which was treated with digitalis. After six months of this medication he noticed a blue tinge on all light objects—flames of an open fire, flowers, paper, and so forth. The digitalis was being administered in only moderate amounts and could not be entirely withdrawn, but its omission for a week caused a complete disappearance of the chromatopsia.

Case 4. Mr. H. K. S. was first seen in 1936, when he was aged 64 years, for refraction. There was some irregular hazing of the lenses and a definite increase in the reflex of the retinal arteries as well as irregularity in their caliber. He was the user of an excessive amount of alcohol, and when next seen, in 1942, had very definite vitreous floaters and a marked increase in the sclerotic condition of the retinal arteries. Later his heart began aching badly and digitalis was administered in rather large amounts. In November, 1943, he was again seen on account of blurring of vision and a yellowish discoloration of all light-colored objects. He had a marked change in refraction which accounted for the blurring of vision. On the withdrawal of the digitalis there was a disappearance of the xanthopsia. Small amounts of digitalis, which were prescribed later, did not bring a return of the discolored vision.

No satisfactory explanation for the occurrence of this visual phenomenon has been offered. It seems to us that it is the result of a disturbance of the cells of the visual cortex rather than of any changes in the retinal elements. The only alterations in the fundus appearance that have been noted are those which are part of the cardio-vascular changes for which the digitalis was prescribed.

CONCERNING THE EARLY OCULAR SYMPTOMS OF MULTIPLE SCLEROSIS*

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In the early ocular symptoms of multiple sclerosis—a disease of unknown

* Read at a meeting of the Spokane Academy of Ophthalmology and Oto-laryngology, October 24, 1944.

causation—there is, in many cases, a retrobulbar neuritis which differs from that produced by other causes. It is characterized by recurrent symptoms from which partial or complete recovery usually occurs early in the disease, and by great variation in the intensity of functional disturbance in relation to the rapid onset of symptoms. Other causes of retrobulbar neuritis such as tobacco, alcohol, lead, arsenic, and other toxic substances or diseases of the brain, do not lead to the same episode of symptoms from which recovery reverts only to repeated attacks before the definite causative factor can be ascribed to multiple sclerosis.

There are some, among whom is Berens of New York, who believe that a chronic posterior sinusitis is a causative factor of retrobulbar neuritis in most instances. There are others, the chief advocate being Benedict of the Mayo Clinic, who believe that posterior sinusitis seldom has anything to do with the production of retrobulbar neuritis. Benedict states that in 10 years' time not a single case of retrobulbar neuritis has appeared at the Mayo Clinic in which a recent attack of acute sinus disease had occurred, nor was severe sinus disease found in a single case of retrobulbar neuritis. Benedict further states that "by a process of elimination of all other probable causes, when the characteristic scotoma can be demonstrated, retrobulbar neuritis often is attributed to multiple sclerosis as an early episode of that disease. Some cases of retrobulbar neuritis have been placed in the category of multiple sclerosis on evidence insufficient to establish that diagnosis, but since the early symptoms of multiple sclerosis are often followed by other unmistakable signs of the disease, and since multiple sclerosis has been proved to be the cause of scotoma in a large number of cases of optic neuritis, particularly the retrobulbar type, the placing in that category of cases of early symptoms may be justified."

In my experience the earliest ocular symptoms of multiple sclerosis are the transitory disturbances of central visual acuity. Patients will complain of central vision being more or less obscured and in testing it will be found, perhaps, that some of the letters on the normal line cannot be distinctly seen. In a few days these symptoms will have disappeared and the line for full normal vision will be read. There may be no other symptoms. Sometimes only one eye will seem to be affected, occasionaly both. No evidence of hysteria may be elicited.

Subsequently, there may be a central or paracentral scotoma, only ascertained by the use of a very small test object. The scotoma may be relative or absolute. It may remain permanent or disappear with the visual symptoms.

In some instances pain is observed on pressure or movement of the eyeball. Indeed, Verhoeff has stated that pain on pressure or movement is characteristic of retrobulbar neuritis, and that he always regards such cases as cases of multiple sclerosis even if the patient never develops any other symptoms of the disease. He believes that multiple sclerosis can be confined chiefly to the optic nerve.

In a certain proportion of cases there is observed a sheathing of portions of the retinal veins with normal arteries. This sheathing may occur "without any visible explanation such as optic neuritis, uveitis, phlebitis, diabetic or hypertensive retinitis, or degenerative changes in the retina" (Rucker).

There are cases, of course, in which there is a sudden onset of blindness, a rapidly enlarging central scotoma, no perception of light after three or four days, with a subsequent complete or partial recovery of vision. This paper is not concerned with such cases. It refers particu-

larly to the patients who complain of mild transitory visual disturbances and in whom, during the first few attacks, not even a small scotoma can be elicited. In some instances the patient will fail to see only a few of the letters on the normal line; in others some of the letters will be described as distorted, a distortion similar to that observed in retinitis. In other instances the symptoms have been attributed to aniseikonia.

For a long time, sometimes for years, sometimes for only months, there may be no other symptoms. The patient may seem to obtain relief from glasses or medication. But later other similar episodes occur, and these recur from time to time until other symptoms more or less suggestive of multiple sclerosis present themselves. A tingling sensation in the extremities and numbness of the hands, arms, feet, or legs; repeated attacks of dizziness or even vomiting or occasional urinary incontinence should arouse suspicion in the physician. Later there may be pallor of the optic nerves in the outer half on one or both sides, and if the ophthalmoscopic examination be made between attacks of the early transitory visual symptoms nothing will be found to account for it.

Of course, after the disease has advanced sufficiently (and this may require years), there will be the classical symptoms of nystagmus, scanning speech, staggering gait, and past pointing. The diagnosis is then definitely established.

These notes are to emphasize the early ocular symptoms and to direct attention to the possibility of multiple sclerosis before any symptoms pathognomonic of the disease have manifested themselves.

The following cases are representative of this discussion and the progress of the disease.

Case 1. G. H., a man aged 36 years, married, was first seen on January 26, 1914. Two weeks earlier he had been struck on the right eye with a very small twig. Two days later he observed diplopia.

Examination showed, O.D. paresis of external rectus muscle and marked pallor of the optic nerve. The margins of the optic nerve of the left eye were blurred. Vision was: O.D. 6/12, Jaeger 1, p.p. 6″; O.S. 6/7.5+, Jaeger 1, p.p. 6″.

The visual field, O.D., was slightly contracted for form and more contracted proportionately for colors. The nose and sinuses were normal.

The patient was treated by daily injections into the temples, alternately, of gradually increased doses of strychnine sulfate, together with gradually increased doses internally of iodide of sodium. In five weeks the diplopia had disappeared and vision was: O.D. 6/7.5 (vs. 6/12); O.S. 6/5− (vs. 6/7.5). In another month vision was: O.D. 6/6+; O.S. 6/6+. No neuritis was observed in either eye, but the optic nerve of the right eye was quite pale in the outer half.

The patient was second in command of the *Hermes,* one of the earliest British men of war to be torpedoed in the North Sea, on October 14, 1914. He was in the cold water of the North Sea for some time before being rescued. A few months later vision of the left eye began to fail. He consulted several London oculists, among them Colonel Elliot, who advised that he had an inflammation of the optic nerve. He was under treatment for some time. He was examined by me again in January, 1918—four years after my first examination. Vision was O.D. 6/12; O.S. 6/30. The muscle balance was good. Both optic nerves were quite pale. The visual fields were much more contracted than they had been four years previously. There was a large central scotoma in the field of the left eye.

While in England the patient had been examined by Granger-Stewart, a distinguished neurologist, who found no lesion except in the eyes. At the time of my examination, four years after the first examination, the Romberg test was negative, the gait good, but the patient became easily tired after walking long distances, and the left leg dragged slightly. He had also recently observed a little difficulty in swallowing, the left angle of the mouth appeared slightly weaker than the right, and there was occasional drooling. He found it exceedingly difficult to hold his urine.

The sinuses were negative to direct and X-ray examination. Fifteen months later the difficulty in the left leg (dragging) had so increased that the patient walked with difficulty, the gait was uncertain, the grip of the left hand weak, and past pointing had appeared. There was no impairment of movements of the external ocular muscles and no nystagmus. From this time, five years after the first examination and the appearance of the early ocular symptoms of temporary diplopia, pallor of each optic nerve, slightly contracted fields, central scotoma, and slightly (temporarily) reduced central vision, the symptoms of incoördination, lack of vesical and rectal control, loss of visual acuity continued gradually to increase over a further period of several years until death finally occurred.

Case 2. O. J., a boy aged 13 years, first examined on April 16, 1932, had worn glasses for four years which he had obtained from an optician. He complained of impaired vision, worse some days than others. There was a moderate myopia of one-half diopter. With correction, vision was: O.D. 6/7.5; O.S. 6/12.

Both optic nerves were paler than normal in each temporal half. The visual fields for both form and color were contracted, and on the tangent screen both blind spots were outside the fields. At 0.75 and 1.50 meters, when tested on the tangent screen, small tubular fields were present. No corneal anesthesia could be elicited; the knee jerks were slightly exaggerated. There were distinct choreic movements of the head, lids, and shoulder. The nose was normal. Because there was a possibility of an element of hysteria (though the optic nerves were pale), treatment was given with this in view. One week later vision was: O.D. 6/6; O.S. 6/12. In another month vision was: O.D. 6/5; O.S. 6/6. A year later vision was again reduced to: O.D. 6/15−; O.S. 6/6− (the reverse of that observed a year previously). The nerve heads were still pale, and vision was obtained only by pointing to separate letters. The patient now (two years after the first examination) complained of "jerkiness" in his legs, "nervousness" when attending school; there was slight anesthesia of both corneas and other stigmata of hysteria that confused the picture. From now on vision became further reduced, the fields smaller, and a central scotoma appeared in each eye; nystagmus occurred, the gait was impaired, and past pointing was observed. A few years later control of the bladder and rectum was partially lost. Coördination was so impaired that the patient had to help himself around the house by holding on to furniture, only a small amount of vision remaining. And this is the condition of the patient, still alive at the present time, 12 years after the first appearance of the ocular symptoms confused with stigmata of hysteria.

Case 3. Mrs. M. C., married, aged 23 years, complained of "blotchy" vision, stating that she saw only part of objects, including test letters on the Snellen chart. The condition had been present about three months. Her second baby was born

one month prior to my examination. She stated that she had observed a similar condition before her first baby was born, but that the symptoms had disappeared after delivery. This time, however, they did not disappear. Vision was: O.D. 6/6, Jaeger 1, p.p. 8″; O.S. 6/7.5, Jaeger 1, p.p. 8″.

The patient was obliged to pick out a single letter at a time and could not read rapidly. The pupillary reactions, blind spots, urine, blood pressure, blood chemistry, blood Wassermann test, were all normal. The visual fields were slightly contracted, and the right lateral half of each visual field was slightly hazy, almost a right lateral hemianopia. Apparently there was a low-grade neuroretinitis involving the upper margin of each disc. Knee jerks were normal, there was no Romberg sign, and the nose was normal.

In a week vision in each eye had increased to 6/5. The Snellen letters were now read quickly without hesitation. The right-sided haziness in the visual fields had entirely disappeared.

In another two weeks there appeared an absolute central scotoma in the field of the left eye, and central vision was reduced to 6/15 in each eye. In another month vision was 6/6 in each eye and the central scotoma was relative instead of absolute. A month later vision in each eye was 6/6—. There was no scotoma. A little fuzziness was observed at the upper margin of each optic nerve. However, there was much aching of the eyes, especially on pressure. This is believed to be possibly a case of multiple sclerosis with the very earliest ocular symptoms. No other symptoms other than those of the eyes have yet been observed.

Conclusions

"Blotchy" vision, interrupted vision, slow vision, changing from time to time, with blurring of the optic nerve or nerves, with or without contraction of the visual fields, central or paracentral scotoma, deep-seated pain on pressure, are suggestive of the earliest stage of multiple sclerosis; hence this disease must be borne in mind whenever these symptoms are observed. The appearance of some of the classical pathognomonic symptoms at some later date will confirm the diagnosis.

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ON BIASTIGMATISM

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The paper on this subject by Linksz and Triller published in the September, 1944, issue of the American Journal of Ophthalmology, must be of interest to all ophthalmologists, and especially to those who have followed up Marquez's writings on the subject. The claim by Marquez, that his bicyclindric method (this name seems appropriate) gives considerably better results than the usual monocylindric methods, has not been borne out by the actual practical tests made by Linksz and Triller. From a theoretical standpoint, and considering only the mechanics involved, one would not expect it otherwise since two obliquely crossed cylinders can always be reduced to a spherocylinder of approximately the same strength. It would seem then at first thought that Marquez's technique was based on a fallacy.

However, the story is not quite so simple as that. The rationale of the bicylindric technique is sound, to my mind at least, if one accepts the premises laid down by Marquez. He firmly believes in the existence of astigmatic accommodation; that is, that the eye can accommodate so as to produce unequal effects in the different meridians. Most observers

deny the existence of astigmatic accommodation on theoretical and practical grounds. But there are a few who believe in its existence, and Marquez is one of them. The question is still an open one—just like the question of the existence of negative accommodation.

Now, astigmatic accommodation, assuming that it exists, must involve a greater effort than does regular spherical accommodation. The drive to make this extra effort presumably comes from a desire to overcome an existing corneal astigmatism. In other words, just as there is a nonvolitional impulse to overcome hypermetropia by means of spherical accommodation, there is a nonvolitional impulse to overcome corneal astigmatism by means of astigmatic accommodation. This would tend to create a dynamic lenticular astigmatism wholly or partly sufficient to neutralize the static corneal astigmatism. The residual astigmatism then, which consists of all the astigmatism in the eye except the corneal component, may consist of some static lenticular astigmatism and, what is more important, of some dynamic lenticular astigmatism.

It would seem that just as in the effort to overcome hypermetropia the accommodation may get into a spasm, so in an effort to overcome static astigmatism, the accommodative effort may produce spasmodic, irregular activity. If, now, the main reason for the drive for astigmatic accommodation were removed—namely, by fully correcting the corneal astigmatism—then the spasmodic astigmatic accommodation would cease and the true refractive error would be found. The residual astigmatism would then consist of the static lenticular plus whatever other astigmatic surfaces there are. The only way to achieve the relaxation of the astigmatic accommodation is by the bicylindric method.

There are, to be sure, some weak points in this rationale. For example, the urge for astigmatic accommodation may come, in part at least, from the presence of static lenticular astigmatism aside from that of the cornea. Furthermore, it is doubtful, even granting all the premises, whether one can produce relaxation of astigmatic accommodation immediately simply by correcting the corneal astigmatism. It would generally take some time for old habits to break down, and for this purpose it were better to have the patient wear the corneal correction for a while and note the effect on the total astigmatism. These weak points, however, do not invalidate the soundness of the rationale behind the bicylindric technique, on the premises promulgated by Marquez.

This defense of the bicylindric technique is not meant to disparage the Lancaster-Regan monocylindric technique. Properly used[1] it is an excellent method and much less complicated than the other. In this technique the ophthalmometer readings are used as a guide for and are modified in the light of the other tests. The Marquez technique, however, is not without merit and is still open for further investigation.

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SOCIETY PROCEEDINGS

EDITED BY DONALD J. LYLE

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

February 7, 1944

DR. SIGMUND AGATSTON, *presiding*

AVULSION OF THE OPTIC NERVE

DR. EDWARD SASKIN described the case of a colored woman aged 24 years, who reported for treatment for a compensable injury to the left eye. This injury was of no significance, but examination revealed an old lesion, of which she had no knowledge, in the right eye. This eye had a disuse exotropia with vision reduced to perception of hand movements at 6 inches. The media were clear. The fundus examination revealed a typical picture of optic-nerve avulsion—optic atrophy, marked diffuse retinal atrophy, obliteration (silver wire) of all retinal veins and arteries except for new-formed vessels below the pale disc, and a dead-white mass in the macular area, about 1½ to 2 disc diameters in size, projecting into the vitreous and towards the disc. There was a similar but smaller mass on the disc. These probably represented old hemorrhages.

The genesis of the picture was thought to be a birth injury.

KERATOCONJUNCTIVITIS SICCA

DR. JOSEPH J. FRIED stated that a woman, aged 55 years, had been suffering from keratoconjunctivitis sicca since 1938. The condition was bilateral and the corneas were markedly affected. All ophthalmic therapeutic suggestions were tried including sealing of the puncta. Despite failure of recanalization of the obliterated canaliculi and application of local ophthalmic measures, there was no improvement until June, 1941, when a combined endocrine treatment with stilbestrol premarin and progesterone were alternately administered. Local ophthalmic therapy was stopped. With two months of endocrine treatment striking improvement was noted in the eye condition and in the associated dryness of the naso-pharynx, skin, pruritis, and vaginal itch. The patient was kept on an appropriate endocrine level and has appeared practically healed for the past three years.

A more decided endocrine approach to keratoconjunctivitis sicca was emphasized instead of purely local treatment and half-hearted attempts with some estrogenic extracts. Topical application of progynon in oil to the conjunctival sac was suggested, based on favorable results obtained in atrophic rhinitis caused by hypogonadism or menopause.

Discussion. Dr. James W. Smith stated that he found Dr. Angus MacLean's water-bath spectacles, with wicks to the outer canthi, effective in keeping the eyes moist.

Dr. Ralph Lloyd said that he saw a woman, in the menopause, with bilateral keratitis sicca with small erosions in one eye. Estrogenic therapy relieved the symptoms and cleared up the erosions. Another case presented a typical keratitis filamentosa following the removal of a dermoid cyst deep in the orbit, which suggested ciliary-ganglion damage as one of the causes of this condition.

Dr. Bertram Kramer, in the belief that microscopic sections show corneal edema, said that he used hypertonic salt solutions to draw off the water. This resulted in improvement but obviously could not be used indefinitely.

Dr. Max A. Goldzieher considered

keratoconjunctivitis sicca a manifestation of a metabolic disturbance of epithelial cells affecting the skin and mucous membranes elsewhere. This disturbance responds to estrogenic therapy. The appearance of the condition in younger women and men does not invalidate the theory of the etiology, since cutaneous application of estrogens has been effective in males. Estrogens are produced in the male body and apparently play a role in cellular metabolism.

Removal of intralenticular foreign body resulting in localized opacity

Dr. Bernard Kronenberg presented the case of a man, aged 39 years, who had an intralenticular foreign body in the right eye. On March 18, 1942, while hitting a chisel with a hammer, a piece of steel pierced his right eye. The following day the vision was 20/70, corrected to 20/40+2 with −.75D. sph. External examination showed a vertical linear scar on the cornea, extending through the entire corneal thickness. The anterior chamber was intact and on the anterior capsule of the lens there appeared to be a small linear opacity which, under the slitlamp, was seen to extend into the nucleus. Ophthalmoscopy revealed an opacity in the lens. The patient was hospitalized and X-ray pictures were taken which localized a radio-opaque foreign body in the lens. The next day the foreign particle was removed by means of a giant magnet. It was first brought into the anterior chamber by applying the magnet to the path of entry. An attempt was made to bring the foreign body out of the anterior chamber through the corneal wound. This was unsuccessful and the anterior chamber had to be opened at the limbus with a keratome and the foreign body brought out through the new opening with a hand magnet.

Treatment with atropine, vitamin-B complex, and vitamin C was instituted and continued for a month. At this time the eye was white and with −.50D. sph. ⌯ −.50D. cyl. ax. 75° the vision was 20/30. One year later the vision was 20/30 with −1.25D. cyl. ax. 75°.

The purpose of presenting this case of intralenticular foreign body was to demonstrate the value of early removal of a foreign body. Even though the anterior capsule was ruptured and the foreign body lodged in the lens, early removal resulted in the formation of a localized lenticular opacity only. It did not, as was expected, result in complete opacification of the lens. The visual result was extremely satisfactory. It was commonly thought that when a diagnosis of lenticular foreign body was made, it was best to defer surgery until the traumatic cataract had matured, when the foreign body could be removed along with the cataract. This case showed that it is advisable to remove the foreign body at the earliest possible moment, so that the rest of the lens will not become opaque, thus insuring retention of binocular vision. The anterior capsule may unite and heal very quickly, not allowing the aqueous to enter the lens and cause swelling and dissociation of the lens fibers. Another reason for early removal is the possibility of siderosis.

Discussion. Dr. Ernst Waldstein said he had removed a foreign body from the posterior lens cortex with the magnet, the lens remaining clear for many months before the patient disappeared.

Dr. Daniel M. Rolett recalled having injured the lens capsule with the tip of the keratome during an operation. A pinhead-sized area of haziness, which was seen four weeks later, did not enlarge subsequently. He believed that small rents in the lens capsule are capable of healing and sealing off the aqueous from the lens.

Dr. Sigmund Agatston believed that opacification following injury of the lens

may be localized when the injury is peripheral.

Treatment of cavernous-sinus thrombosis with penicillin and dicoumarin

Dr. Bertram S. Kramer presented the case of a married woman, aged 40 years, who was admitted to the hospital with a diagnosis of orbital cellulitis of the right eye, five days after two molars were extracted on the left side. The right eye showed a complete external and internal ophthalmoplegia. The left eye showed no dilated veins but there was edema about the entire eye. Later the right eye developed a thrombosis of the central retinal vein and, because of an extension of the edema, a diagnosis of cavernous-sinus thrombosis was made. Sulfadiazine was administered in large doses, but the patient showed no response. Penicillin was then given along with sulfadiazine. Because of neurologic signs which suggested that the thrombus was extending backward, she was given dicoumarin by mouth. Shortly thereafter both tooth sockets began to ooze. The patient lost the sight of the right eye but recovered from the cavernous-sinus thrombosis and left the hospital five weeks later. She also had severe diabetes and hypertension. It was Dr. Kramer's belief that the dicoumarin helped her condition materially.

Discussion. Dr. Daniel Kravitz said he had treated a case of cavernous sinus thrombosis following cellulitis of the face. Staphylococcus aureus was cultured from the blood. Recovery occurred in less than two weeks on heparin and penicillin, the latter administered intravenously and into the orbit through drainage tubes.

Dr. Kramer said that dicoumarin is believed to be safer than heparin. It has no action on the liver or erythrocytes, its only danger being the tendency to hemorrhage when the dosage is not controlled. In this case the negative blood culture was explained by the immediate administration of sulfathiazole. Unilateral or bilateral occurrence in cavernous-sinus thrombosis depends on whether the thrombus extends directly backward or through the intercommunicating veins to the other side.

Dr. Alfred Kestenbaum questioned the diagnosis because of the rarity of unilateral cavernous-sinus thrombosis, absence of chemosis at the onset, and lack of engorgement of the retinal veins; in addition, because facial and trigeminal paresis are not among the signs of cavernous-sinus thrombosis.

Aniridia. Treatment of complicated glaucoma with doryl

Dr. Daniel Kravitz said that he considered the greatest advance in the medical treatment of glaucoma in the past few years the synthesis of a large group of cholinergic drugs: mecholyl, prostigmine, furmethyl, and doryl or carbaminoylcholine. Doryl is a powerful parasympathetic-system stimulator, and is many times as active as acetylcholine and in addition is very stable. It is likewise a powerful peripheral vascular dilator. In the following unusual case he had had a gratifying result with doryl.

D. S., a man aged 28 years, complained of sudden loss of vision in the right eye which occurred two weeks previously. He had had very poor vision since birth and six years ago had suddenly lost the vision of the left eye.

The vision of the right eye was reduced to the perception of shadows. There was a complete aniridia. The lens was swollen and diffusely milky white. The tension was 20 mm. Hg (Schiøtz). There was absolute glaucoma of the left eye and complete aniridia. A staphyloma above involved the ciliary body. The lens was cataractous and degenerating.

A linear lens extraction was performed three weeks later. The postoperative

course was uneventful. The vision was 20/200 with correction. Eleven days following discharge from the hospital the patient experienced severe pain in that eye. Examination showed that the tension was 4+ and the vision was reduced to light perception. The tension was not relieved by pilocarpine, eserine, or prostigmine alone or in combination. Doryl kept the tension down to 20 mm. for almost two years and the patient was able to carry on his usual work.

Discussion. Dr. James W. Smith stated that he had four cases of partial aniridia in one family. Two patients had glaucoma, one requiring surgery. In all cases of aniridia there is a rudimentary iris, often adherent to the cornea, which probably accounts for the 25-percent incidence of glaucoma. Aniridia shows the greatest hereditary tendency of any ocular condition.

Dr. Kravitz, in closing, stated that gonioscopy showed the presence of an iris root apparently turned in on itself, and an open chamber angle. The mechanism of the action of doryl is not clear.

Intracranial aneurysm with ocular signs

Dr. James W. Smith presented a woman aged 34 years, who had negative ocular, medical, and family history. She suddenly developed low frontal headaches on the left side. Within two weeks ptosis and partial oculomotor paralysis occurred. The head pain persisted, increased in severity, extended to the back of the left eye, and was followed by complete external and internal ophthalmoplegia. Diagnosis of aneurysm of the left internal carotid artery was made. Three weeks after the onset of headaches the patient fainted and was hospitalized for a subarachnoid hemorrhage.

Through neurosurgical operation, three weeks later, an aneurysm was exposed at the base of the skull, compressing the third cranial nerve. Six weeks after operation the ptosis cleared and the excursion of the internal rectus muscle had returned to half of normal. The other muscles supplied by the oculomotor nerve responded slowly and incompletely. When the patient was seen six months postoperatively, only the internal rectus movement was normal.

Abnormal lid movement was present due to misdirection of fibers of the third nerve in regeneration. Adduction produced a 4-mm. elevation and abduction produced a 2-mm. drooping of the upper lid.

An atypical pupillary reaction was noted. The pupil was dilated to 5.5 mm. and did not react to direct and consensual light stimulation. Adduction produced a contraction of 1 mm. and convergence caused an additional 0.5 mm. of contraction, suggesting a type of unilateral Argyll Robertson pupil. Pupillographic investigations have not been completed.

The eyegrounds and visual fields were normal throughout the clinical course. The right eye was normal.

Discussion. Dr. Ferdinand Koch pointed out that there exists a basic difference between the situation presented by Dr. Smith and that of the supraclinoid intracranial aneurysm. The latter, after a more or less prolonged period of diagnostic and prognostic confusion, ends fatally. Dr. Smith's case is an instance of a mycotic intracranial aneurysm in a typically infraclinoid location in a patient not yet in middle life.

Divergence excess and other aberrations of muscle tone

Capt. Adolph Posner (MC) presented a new concept regarding the interpretation of divergence excess which has been published in this Journal (1944, v. 27, Oct., p. 1136).

Discussion. Dr. Joseph Pascal agreed that many phorias are artifacts due to

dissociation of the normal binocular functioning of the eyes. The case showing an apparent esophoria and exophoria is explained by eye dominance, accommodative activity of the fixating eye, and old habit. For example, diplopia may occasionally be elicited with a red glass before the nondominant eye which, giving up fixation, permits the phoria to become manifest; the dominant eye, which maintains fixation when the red glass is before it, shows an orthophoria.

Dr. Bertram Kramer pointed out that phylogenetically and embryologically the eyes are on the side of the head and their forward growth is not complete, hence a positive angle gamma and divergence for distance is normal; convergence must be acquired. Alternating hyperphoria has been explained by the greater strength of the inferior obliques as compared to the superior obliques.

Dr. Arthur Linkz explained the apparent eso-exophoria on the basis of a possible paresis of the left internal rectus muscle. Fixation with the right eye would then permit divergence of the left eye. Fixation with the left eye, because of the greater innervational impulse required, would call first for marked dextroversion, and then for overconvergence of the right eye.

Dr. Morris Davidson had observed a similar phenomenon, an esophoria of one eye when the other eye, with a macular lesion, attempted to fixate.

Dr. Alfred Kestenbaum explained the eso-exophoria on the basis of the greater convergence impulse when fixating with the hyperopic left eye as compared to fixation with the emmetropic right eye.*

Leon H. Ehrlich,
Secretary.

* EDITOR'S NOTE: And see discussion of this subject by Walter B. Lancaster, M.D., in this Journal (1945, v. 28, Jan., p. 96).

ROYAL SOCIETY OF MEDICINE

SECTION OF OPHTHALMOLOGY

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MR. F. A. JULER, *president*

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EMBOLISM OF THE RIGHT INFERIOR RETINAL ARTERIAL DIVISION

MR. HUMPHREY NEAME presented S. G., a housewife, aged 23 years, who was seen for the first time at Moorfield's Eye Hospital, with a history of migraine. The corrected vision was 6/9 in each eye. Twenty-one months later the patient complained of partial loss of sight in the right eye for five days. It was ushered in with a migraine phenomenon with colored lights. She gave a history of occasional complete "blackout of one eye" lasting for a second, and then the appearance of spots lasting for about 10 minutes, followed by severe headache. The history was suggestive of migraine.

Examination of the fundus of the right eye showed a cloudy area of retina occupying the inferior temporal quadrant and part of the inferior nasal quadrant. Retinal vessels near the disc were somewhat obscured. With the pupil of the right eye dilated, the vision, with correction, was 6/60, with eccentric fixation. The vision of the left eye, with correction, was 6/6. A pale-yellowish-colored block was seen in the inferior temporal artery at its division from the inferior nasal artery.

Physical examination revealed nothing abnormal in the circulatory system. Blood pressure was 130/80. The bleeding time was 3¾ minutes. Coagulation time was 1 minute 50 seconds. Wassermann reaction was negative.

Three months later the yellowish block was much less clear, but a bright reflection was seen on the somewhat enlarged artery at that site. The artery wall was visible as a pale grayish border on the optic disc. The color of the fundus below was now normal. Visual fields, as charted on the Bjerrum screen, showed loss of the upper half of the field to 2/2,000 white. The vision of the right eye, with correction, was 6/18, not with direct fixation.

Bilateral ptosis and atypical slant eyes associated with unilateral syndactyly, adactyly, and brachyphalangy

Mr. D. V. Giri presented D. B. D., a boy aged 18 years, who complained of headaches. There was nothing unusual in the eyeballs. The palpebral apertures were narrow, the right greater than the left, and obliquely set with the internal canthi lying higher than the external.

On the left hand the thumb and index finger were syndactylous throughout; because of this the thumb was bent at the phalangeal joint and the index finger, which seemed to have only two phalangeal bones, the distal one of which was poorly developed, was curved toward the thumb and prevented from attaining greater length than the thumb. There were two nails which were fused into a ridge where they met and were somewhat concave laterally on either side of the ridge. The middle and ring fingers were absent, and the little finger, which had only two phalanges, appeared stouter than normal. There was plenty of power, flexibility, and manipulative skill in the hand. There were no other abnormalities in the body.

The father had atypical slant eyes similar to those of the patient, but no ptosis and the mother had bilateral ptosis, but the eyes showed no slant. The patient had two brothers who had no abnormality, except that the one was unusually tall, measuring 6 feet 6 inches. There was no evidence of heredity in the parental pedigrees.

It is possible that some or all of the abnormalities, either modified or unmodified, will be inherited by some of the patient's progeny, and by all, if the mate also contributes similar abnormal genes.

Discussion. Mr. O. G. Morgan said that from a eugenic point of view this condition was not a very serious one as it only produced a very slight disfigurement and a defective hand on one side. There was no mental deficiency. Thus, there was probably no need to advise against marriage in this case.

Corneal foreign body (glass splinter) projecting into anterior chamber

Mr. Victor Purvis presented L. S., a boy aged 14 years, who had broken his glasses and a small piece of glass became embedded in the deeper layers of the cornea and projected for the greater part of its length into the anterior chamber. The lens and vitreous were clear. The fundus was normal. The vision, with correction, was 6/9. It was decided at the time to make no attempt to remove the glass, and the eye had remained unchanged since the injury, five years ago.

Two cases of central venous thrombosis

Mr. Victor Purvis presented these cases to demonstrate the difficulty of making a diagnosis of this condition when it is of long standing. In the one case there was massive exudation, the hemorrhages having become for the most part absorbed; in the other case the hemorrhages and exudates had been completely absorbed, leaving two areas of retinal cystic formation, at the macula and over the nasal half of the disc. This

cystic degeneration of the retina in the second case is not common, but is of great interest, for it has all the appearances of a localized detachment.

THE MICRO-DIAGNOSIS OF CONJUNCTIVITIS ARTEFACTA

MR. JOHN FOSTER presented a paper on this subject. He stated that conjunctivitis artefacta is a term of uncertain meaning; that he would define it as conjunctivitis knowingly self-induced to obtain sympathy, compensation, or evasion of military service. Historically, the first type is as old as hysteria and mendicancy, the second as the Workmen's Compensation Act, and the third was the subject of a mass prosecution in the French Army in 1807.

Diagnosis by microscopic identification of the causative agent was foreshadowed by Conan Doyle's "Monograph on 114 varieties of cigar ash" mentioned in the "Sign of The Four" but was first applied systemically to conjunctivitis by the French in the last war. The method has the advantage of rapidity, and, with a little organization, of simplicity. He said that in practice the chief difficulties of application are due to (1) difficulties in collecting and preserving specimens; (2) lack of proper though simple apparatus and reagents at the material time; (3) vague or absent description of the microscopy of some irritants. To appreciate the use and limitations of the method conjunctivitis artefacta must be shortly considered.

Method of production. The irritants recorded in the literature are most varied, ranging from leech bites to insertion of dental tartar and transfer of trachoma.

Traditional knowledge (an individual may produce a local epidemic) based on a desire to avoid permanent injury to sight, and accessibility of material such as condiments, limits the cause as a rule in Allied Territory to the list given below, in which signs peculiar to specific irritants are mentioned. This enables a study of the microscopy of most possible agents to be made in advance.

The general characteristics, though not invariable, are as follows: (1) Improbable etiology and unexpected relapse. (2) Exacerbation by ordinary treatment. (3) Secretion catarrhal rather than purulent. (4) Purulent discharge, if present, most marked in the morning. (5) Striking chemosis with subconjunctival hemorrhage and little discharge. (6) Unilateral. (7) Predominantly affecting lower lid and lower half of cornea, owing to gravity and the tight fit of the upper lid. (8) Undue prolongation of conjunctivitis following minor corneal injury.

The classification of usual causes (with special characteristics) follows:

Direct trauma. Rubbing with saliva-covered finger, match head, pencil (copying ink). Tendency to subconjunctival hemorrhage.

Local vegetable irritants. Mustard, tobacco, snuff, and pepper. Particles tend to "string" themselves on threads of mucus. The Chinese use tobacco as an eye treatment.

Oriental vegetable irritants. Pulp of jequirity, croton and castor-oil seeds. Acute chemosis with small central area of necrosis leading to a local symblepharon.

Unorganized deposits. Soot (as solid or straw smoke) slack, coal, dust, earth, and cigarette ash. May be found in one lower fornix only. Being only slightly irritant, they are often inserted just before examination. Must be differentiated from airborne dust, which adheres in great amounts to any blob of pus at inner canthus, but gets into the lower fornix only in high wind or filthy atmosphere. The injection produced is brighter red than that due to the local vegetable irritants.

Calcium salts. $Ca(OH)_2$, $CaSO_4$. Heavy corneal scarring with a petrifying incrustation of the lashes has been observed from mortar and a conjunctivitis has been produced by toothpaste, the features of which, except that it is both severe and chronic, are not familiar.

Soap is undetectable microscopically, and even in quantity is difficult to identify for forensic purposes unless it contains carbolic acid (Roche Lynch). As normal pH of the tears is 7.8 and household soap is alkaline, British Drug Houses phenol red paper (pH 6.8 to 8.4), which is yellow or faintly pink, in normal tears, might be used to detect recent insertion. Catarrhal inflammation, particularly rosacea, seems to increase the pH a little. Tintometric methods are useless, as the proteins and variable CO_2 content of tears prevent an accurate estimate, and good toilet soap is neutral. A slip of old dry soap may even be acid.

Fluids. Urine, petrol, zinc chloride (killed spirit), OdoRoNo, whose composition is not listed in Martindale but probably, like most deodorants contains betanaphthol.

Signs of the foregoing type, although they indicate probabilities rather than certainties, may be so clear that the surgeon and military or legal authority are convinced.

In other cases where the signs are not clear-cut, to avoid injustice a confirmation by concealed observation or confession may be necessary. As malingerers do not, as a rule, wish to blind even one eye permanently, an explanation of the serious condition of the eye, plus a query regarding a self-applied treatment may elicit a confession. Sometimes direct questioning is enough.

If not, the following methods of examination may clarify matters:

(1) To exclude natural causes: (a) syringing of the lacrimal sac; (b) consideration of overtreatment (a patch test); (c) exposure of upper fornix (Terson's method).

(2) Examination of conjunctival smear: Bollack found a marked eosinophilia in the discharge in 10 cases of chronic conjunctivitis artefacta. Unfortunately, although this is only found naturally in pemphigus, spring catarrh, and the rare "necrotic staphylococcal" conjunctivitis, it may not help much, as it may be peculiar to the rare variety due to ipecacuanha. One of Bollack's cases was of this nature, another caused by an unspecified insecticide, and the other eight were uncertain though probably due to ipecacuanha also. He had never used this test himself.

(3) The culture of the conjunctival sac is alleged to be negative in ipecacuanha cases, and frequently so in others. He said that he found that streptococci or mixed secondary infection may occur in artefacts due to dust and tobacco.

(4) Occlusive collodion bandage. He said he had heard senior colleagues describe this measure as impractical, and it is useful only as an in-patient measure, where it can be watched. A small pad only should be put over the eye, with several layers of collodion-soaked gauze to follow. Special care should be paid to the upper nasal edge, where it is liable to separate, and the surfaces for adhesion are narrow. Blegvad has suggested a mask like the old "P.H." helmet (used in the last war as an antidote to phosgene), with watchglass eyepieces, and an opening for the mouth only. Where continuous observation is not possible, Wright has suggested a tarsorrhaphy complete except for 2 mm. at either end. It is possible that thermoplastic methylacrylate may solve the mechanical side of this problem.

Clinically, if the eye is irrigated before application, the bandage may cure the eye

in three days. If secondary infection is well established, this may be exacerbated, and cloud the issue.

(5) Search of belongings on admission including purse, back of watch, steel helmet lining.

(6) Microscopic examination for irritants: This is an adjunct only to other clinical methods, and effective only in cases due to causes in the following groups: local vegétable irritants, unorganized deposits, and calcium salts. It is rapid, applicable at the first examination, and a positive finding is conclusive.

Persistence of detectable deposit. He said he had no accurate information on this point, but had found excessive coal-dust deposit three days after, and fine wood dust two days after exposure in "naturally" inflamed eyes. In an artificial case the deposit is heavier, and as Caiger has indicated, may be renewed by the patient, as the effects may be transient. If nothing is found at the first examination, and the eye is recovering: (1) Give warning via a subordinate of a "special" examination, next day. (2) Do not irrigate the eye prior to examination. (3) After remarking that the eye is looking better, leave the patient alone in the middle of the examination, after insertion of a drop of saline to "dilate the pupil."

The technique of collecting and examining specimens was described. Microscopic descriptions with photographs of deposits were presented.

Discussion. Lt. Col. R. E. Wright said his experience was concerned with irritant remedies as a cause of blindness in the East rather than the self-inflicted conjunctivitis due to irritants defined by the title of Mr. Foster's paper.

Two varieties of self-inflicted injuries are: Those produced deliberately with intent to evade duty such as occur in malingerers in the military or civil life, and those produced because of some underlying psychogenic affection. These have much in common, but neither offers definite clinical criteria. The malingerer's lesion is frequently one of the lower fornix on one side. One may identify the irritant *in situ,* or base diagnosis on a localized lesion, its appearance, the type of individual exhibiting it, and intuition; a suspicious history may help. In the Madras hospital "policeman's eye" was diagnosed offhand in government employees for the most part correctly. Seldom had one to use detective methods. The diagnosis was affirmed and suitable treatment adopted, for example, penciling the upper palpebral conjunctiva with 2-percent silver nitrate. This frequently answered, the patient considering the treatment too great a price to pay. The malingering soldier may require an occlusive bandage. If the cornea is not involved—it seldom is in malingerers—and infection excluded, one may occlude the eye for some days, placing a suitable ointment in the fornix. The eye-pad may be fixed to the circumorbital skin with collodium flexile. A plaster of Paris bandage over a well-padded and bandaged eye can be split behind, removed, and refastened any time after setting. The response of the conjunctiva to an irritant varies with the individual. All the appearances of a conjunctivitis artefacta may be produced by a coagulum of 10-percent protargol. Slaked lime as used by betel chewers in India, portions of chewed tobacco, or anti-gas ointment may only produce a red velvety fornix. Identification of irritants is best left to a chemist with forensic experience. Quicklime produces a violent reaction with conjunctival (and maybe corneal) necrosis. He said he had seen total hypopyon after a quicklime fornix injury without direct corneal damage. A localized eschar or croupous membrane, on the apposed surfaces of the lower fornix, may be sug-

gestive of conjunctivitis artefacta. In such cases one should exclude a Klebs-Löffler or other virulent infection. A bacteriologist should always be consulted; he may identify an unexpected organism indicating the method of infection.

Excretions may enter the eye deliberately or accidentally. Certain lower-fornix eschars and croupous lesions cannot be identified as self-inflicted, even when exhaustive bacteriologic investigation proves negative, and microscopy reveals merely eosinophilia with uncharacteristic granulation tissue. These obscure pseudomembranous lesions tend to have sequelae like conjunctival burns. Their surface healing is accompanied by subconjunctival solid edema, deep fibrous-tissue formation, late shrinkage, pocket formation, symblepharon, and sometimes the eventual picture of so-called essential shrinkage. This leads toward a more complex field, the chronic granulomata, outside the subject under discussion.

In psychoneurotics the upper conjunctiva is sometimes the seat of election and the foreign substance perhaps oftener less irritant in type.

Major E. F. King said that there was a condition of the cornea which he had found to be helpful in these cases; namely, in the lower third of the cornea a curious punctate drying of the epithelium. This was quite sharply confined to the area stated and was obviously an effect of irritation from the outside.

With regard to occlusion of one eye with a shield or by some other method, this always seemed to raise its own problems. The ventilation of the eye was interfered with, which in itself led to a certain amount of irritation.

Mr. Humphrey Neame said that there had been no great emphasis on the right- or lefthandedness of these persons. In suspicious cases it was worth while testing whether the person was righthanded and righteyed. He recalled one case in which the left eye was maltreated, and the person was lefthanded. He was quite convinced from the appearance that this was an artefact.

Mr. Frederick Ridley said that he had a case similar to that described by Major King, which also showed fine superficial staining of the lower half of the cornea. He was almost sure the patient was a malingerer. This staining might prove to be of real diagnostic importance. He wondered whether Mr. Foster had thought of the use of sodium alginate to pick up and fix fine dust or other material introduced into the conjunctival sac. The sodium salt was precipitated as calcium alginate and the tough jelly so formed was a suitable embedding material for subsequent staining and the microscopic examination. A kallodent mask was easily made and was an effective shield if tied above and below the ears and the knot sealed.

Mr. Foster, in closing, said that he regretted he did not know anything about sodium alginate nor had the relationship between right- and lefthandedness come within his purview. By analogy with skin diseases there might easily be some relationship between handedness and the inflamed eye.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

SECTION ON OPHTHALMOLOGY

February 17, 1944

DR. WARREN S. REESE, *chairman*

MARCUS GUNN PHENOMENON

DR. EDMUND B. SPAETH and DR. JAMES S. SHIPMAN presented two cases of the Marcus Gunn phenomenon. The first patient had completely immobile eyeballs due to surgically demonstrated

fibrosis of all the extraocular muscles. The levators, however, were surgically demonstrated to be normally present. The lid elevation was bilateral, and connected with both jaw opening and closure. In the second patient the condition was unilateral. It showed the classical and usual picture of lid elevation associated with the action of the contralateral pterygoids.

The etiology and theories connected with the development of this syndrome were discussed, the cases illustrated by moving pictures, and the surgery for the correction of the syndrome presented.

Discussion. Dr. F. C. Grant said that the identity of the pathways over which the afferent or efferent fibers pass to produce this phenomenon is so definitely shrouded in mystery that it is unnecessary to go into a discussion of this aspect of the subject. Drs. Lewy and Groff did some work on this subject which seemed to suggest that the first division of the trigeminal nerve has much to do with the phenomenon, but those experiments were not so conclusive as was expected. He said he was much interested in having an ophthalmologic opinion on the treatment of this phenomenon.

He recalled a case seen about five years ago which presented exactly the same features as those shown in Dr. Spaeth's second case, with the definite elevation of one eyelid on contralateral movement of the jaw, suggesting that the pterygoid innervation on the ipsilateral side was always involved, for when that muscle was moved, there was a corresponding elevation of the eyelid. It was suspected that if the movements of the pterygoid were interfered with, and it were impossible for the patient to move his jaw to the contralateral side, the upper movement of the lid might possibly be prevented. In this case, the third division was blocked on the right side with procaine, and it was found that the patient could not move his jaw to the left, the motor root was paralyzed, and upward movement of his eyelid was abolished. The novocaine was reinforced with alcohol, and it was noted that, while 95 percent of the pterygoid function was paralyzed, the patient could still move his jaw about a quarter of an inch to the left. With that movement, or effort, the spasm was still present. Operation was then performed and the third division of the right fifth nerve was cut together with the motor root. Serious trouble was encountered because the patient had a postoperative hemorrhage that almost cost him his life. As a result of this complication, there was a complete paralysis of the motor fifth, and with that degree of paralysis he could not move his jaw to the left. Consequently, he had none of the associated movement. He recovered completely from the third- and seventh-nerve paralyses. Eight months following operative intervention there was slight evidence of the oculomotor weakness, but it was impossible for him to move his jaw to the left, and even with forcible movement of the jaw, there was none of the associated movement that had accompanied the contraction of the pterygoid prior to operative interference.

He stated that he would be reluctant to suggest operative intervention in the treatment of these cases, especially if it were going to involve the patient in the possible hazards consequent upon postoperative hemorrhage. Fortunately, this is a very uncommon operative complication.

If there is an ophthalmologic surgical procedure to offer these people, he said he thought that it would probably be preferred to that which he described. The only excuse for operating on this patient was the fact that, in going through the literature, he had found that there were 100 cases of Marcus Gunn phenomenon

and in none of these had any attempt at all been made to correct the associated movement. This was the 101st case, and the result has been seen.

Dr. William Zentmayer said that cases showing anomalous associated action of the muscles of the face and eye have been classified by Friedenwald as follows: (1) Contraction of the levator palpebrae superioris with the act of moving the jaw or swallowing. (2) Contraction of the orbicularis associated with movement of the jaw, or contraction of the various face muscles after facial paralysis. (3) Contraction of the levator palebrae superioris associated with abduction or adduction of the eye.

To these he suggested the additional classification: Contraction of the frontalis associated with abduction of the eye.

The committee appointed by the Ophthalmological Society of the United Kingdom to investigate Gunn's case reported that the phenomena were to be explained by innervation of the levator both from the nucleus of the third nerve and the external pterygoid portion of the nucleus of the fifth nerve.

In Harlan's case, reported before the Section, there was rapid winking of the left eye during mastication, which gave the impression of a blepharospasm. It was an acquired condition in a four-year-old child and followed an attack of typhoid fever.

According to Harman and Topolanski elevation of the alae of the nose accompanies normal blinking of the eyes in 20 percent of persons examined. Harman's explanation of the Gunn phenomenon is that these cases represent atavistic anomalies as in the shark; the fifth and seventh nerves are so closely associated that they are called the "facial complex."

Fuchs has described a group in which the upper lid is raised in attempts at adduction and falls in abduction. The reverse of this may also at times be observed. Usually there is associated ptosis, and there may or may not be paresis of the lateral muscle. Fuchs assumed that the excessive nerve energy that is supplied to the paralyzed nerve overflows into the neighboring nuclei.

He said he had observed contraction of the frontalis in abduction of the eyeball in a man, aged 20 years, who had an esotropia of 12 degrees, the right eye being used for fixation. There was some limitation of the outward excursion of the left eye. As the fixating object was carried to the left, the left eye stopped when it reached the midline, and the elevation of the left brow began as soon as abduction started and reached its maximum when the eye by forced action almost reached the external canthus. There was no accompanying elevation of the lid or widening of the palpebral fissure. There was neither ptosis nor palsy of any of the ocular muscles. The eyes were hyperopic. There was no evidence of organic disease of the nervous system.

In Wilbrand and Sanger's treatise on "Die Neurologie des Auges" a similar case is reported.

Dr. Francis Heed Adler stated that at this time it is probably fruitless to suggest another possible explanation of this interesting condition. It seems curious, however, that no one has called attention to the possibility of the cortical or subcortical site of the lesion. It is well known that the vast majority of these cases are associated with congenital ptosis. None of the ocular muscles are represented individually in the frontal cortex, with the exception of the muscles of the lid. The levator muscle is represented in the foot of the second frontal convolution adjacent to the representation of the muscles moving the jaws.

It seems quite possible, therefore, that a lesion or a lack of development of the

cells in this area could easily account for this phenomenon. At the present time, however, there is no evidence on which to base this hypothesis, but it seems plausible.

Dr. James S. Shipman said that he had seen the first case that Dr. Spaeth presented, and had asked Dr. Spaeth in for consultation. He at once made a diagnosis, and suggested the operative procedure which was followed. It is questionable whether this procedure will produce permanent results. As Dr. Spaeth had pointed out in his presentation, Marcus Gunn phenomenon is congenital, and the pseudo Graefe phenomenon is very often the result of similar anatomic possibilities, that is destruction of third-nerve fibers, which, with regeneration, result in misdirection, although in this instance this misdirection occurs within the trunk of the regenerating third nerve. The surgery for this, the pseudo-Graefe syndrome, is, in his opinion, the same as that required for the Marcus Gunn phenomenon. First the conversion of the case into one of paralytic ptosis by the surgical destruction of the levator and following this the correction of that paralytic ptosis. The abnormal movements which the patient develops in each of these types of pathologic associated reflexes are not greatly dissimilar. Such a case was seen not many months ago.

Dr. Spaeth had pointed out that in his opinion the basis of the Marcus Gunn phenomenon is a miscellaneous direction or abnormal regeneration of nerve fibers. Dr. Shipman said that the question in his mind is whether this patient three or five years from the time of operation will still have the same appearance that he has at present, and if he will still be free of this phenomenon of jaw-winking. He suggested that a few more years be allowed to elapse so as properly to evaluate the lasting effects of the procedure as followed in the cases presented.

Dr. E. B. Spaeth stated that the longest time a case so far had remained corrected was over four years. Apparently, this was a permanent correction. There is no reason to doubt the permanency of these results.

Dr. Grant's demonstration is certainly conclusive, as he showed. With regard to Dr. Adler's discussion he said he does not believe that the Marcus Gunn phenomenon is one of cortical stimulation, even though Walsh's patient, who developed a lid elevation when he became interested in an attractive member of the opposite sex, and another youngster who developed an elevation of the upper lid when he became angry, do suggest a cortical relationship.

Precipitous development of optic neuritis and cataracts in a case of hypoparathyroidism

Dr. Walter I. Lillie presented a case of bilateral optic neuritis and precipitous cataractous formation associated with postoperative hypoparathyroidism.

From the ophthalmologic aspect, this patient presented many interesting features. First, she had had a mild exophthalmos since the age of 10 years, which had not changed in character throughout the entire course of the condition.

Second, blurring of vision associated with acute bilateral optic neuritis developed precipitously two months after thyroidectomy, but well in advance of any of the clinical signs such as the dermatitis and tetany associated with convulsions.

Third, at the time of the first examination at Temple University Hospital, the lens in each eye showed only a few small discrete opacities in the cortex anterior to the posterior capsule. Opacifications were so slight that the fundus examination was not interfered with in either eye. Definite edema of the disc was visible with the ophthalmoscope. The ocular examina-

tion at this time revealed a classical optic-neuritis syndrome.

Fourth, the rapid development of cataracts to maturity and hypermaturity in the course of 10 days' stay in the Hospital was of extreme interest. Unfortunately, it stopped any possibility of fundus examinations to see how the optic neuritis was responding to general treatment.

Fifth, following successful cataract extraction in each eye, the fundus examination was negative, and the visual acuity normal.

Discussion. Dr. Charles L. Brown called attention to the fact that in this case the general condition was a very complicated one, manifested by a very extensive metabolic disturbance. He was inclined to think that besides a severe chronic hypoparathyroidism there was also diminution of thyroid function. There was also reason to believe that a nutritional deficiency entered into this picture.

The last-mentioned point is not clearly understood, but it is apparent in other cases that have been reported. In one particular case, which he reported in collaboration with Dr. Norman Learner, there was evidence of nutritional deficiency, particularly of vitamin B. It was also believed that vitamin-D deficiency might be a factor. This case showed indications of skin manifestations during the part of the year when the patient was not exposed to the usual amount of sunshine. It is interesting to note that many of these ectodermal changes that have occurred in connection with postoperative thyroid and parathyroid conditions seem to have been particularly prevalent in those patients who were operated on between January and May. When referring to the hypoparathyroid state, it is natural to turn to the disorders associated with calcium and phosphorus metabolism. How much this widespread metabolic disorder has to do with the formation of cataract with the occurrence of other ectodermal-tissue changes, one can only speculate.

It is not particularly rare for cataracts to occur as one of the manifestations or features in chronic tetany. In past years it is apparent in the literature that the occurrence of cataracts is recognized as being quite frequent in the nutritional tetany of young adults. Those who have described such cataracts have called attention to the characteristic subcapsular distribution of these opacities. There has been some indication that cataracts occur rather rapidly. In 1941, in one of the cases reported by Emerson, Walsh, and Howard, there is said to have developed a bilateral-cataract formation which led to complete blindness within 4½ months. One of the very interesting, and perhaps significant, points in this case is the rapid appearance of cataract, as Dr. Lillie stated, within 10 days while under his observation. It is interesting that AT 10, or dihydrotachysterol, plus calcium, has been an effective therapeutic measure as far as the calcium-phosphorus metabolism is concerned, and it would have been interesting to see if this substance impeded the progress of these cataracts had they not been so rapidly formed.

Foster Kennedy syndrome with fusiform aneurysms of the internal carotid arteries (bilateral)

Dr. I. S. Tassman said that a married woman, 32 years old, suffered from pain over the eyes and loss of vision in the left eye over a period of eight months prior to coming to Wills Hospital. Other subjective signs and complaints were practically negative. Ocular examination when the patient was first seen by Dr. Tassman revealed the presence of a Foster Kennedy syndrome. There was papilledema of at least 3 diopters with good vision in the right eye, and optic atrophy with almost total loss of vision in the

left eye. The presence of a suprasellar lesion was suspected. Definite diagnosis was made at the time of operation, which revealed the presence of bilateral fusiform aneurysms of the internal carotid arteries with anomalous loop formation in the course of the arteries, and compression of the optic nerves. The case might be classed as one of congenital origin.

On admission to Wills Hospital, November 17, 1943, the vision was R.E. 6/6, partly; L.E. ability to see hand movements at 10 inches. The lid action was good. There was no nystagmus. Ocular rotations were full. The pupil, cornea, conjunctiva, and intraocular pressure were normal in each eye.

Visual fields of the right eye showed moderate concentric contraction of the peripheral field, and a slight enlargement of the blind spot. With the left eye there was ability to see hand motion just around central fixation.

Examinations of the ears, nose, and throat were negative. X-ray pictures of the skull and sella turcica showed no evidence of pathologic change. The sinuses were negative.

Results of laboratory studies were as follows: urinalysis, negative; blood sugar, 104 mg.; blood Wassermann, anticomplement; Kahn, negative; spinal-fluid pressure, 110 mm.; cell count, 0 cells; globulin, negative; colloidal gold curve, 0000000000 percent; total protein, 25 mg.; and Mantoux test, negative.

Findings from the neurologic examination suggested the presence of a suprasellar lesion either neoplasm or aneurysm, with the ocular finding of Foster Kennedy syndrome. Other localizing signs were absent. Air encephalogram was done on December 2, 1943, followed by a roentgenologic study which indicated a possible suprasellar lesion.

Craniotomy was performed on December 14, 1943, over the left frontal lobe. Just beneath the optic nerve of the left eye there was seen a fusiform aneurysm of the internal carotid artery, which after passing out of the skull formed a complete loop into the region of the sella, and then passed backward to its normal location to pass laterally to the middle cerebral artery. On the right side there was a similar fusiform aneurysm of the internal carotid with a mass of tiny veins on it just beneath the optic nerve. This pressed the optic nerve backward tightly against the optic foramen. It was impossible to do anything with the lesion.

Arteriography was done on January 14, 1944. The carotid arteries on the right side were exposed and 15 c.c. of 35-percent diodrast was injected rapidly into the internal carotid. The X-ray picture which was taken following this showed a tortuous internal carotid artery just beneath the optic nerve.

Craniotomy over the right frontal lobe was performed on January 19, 1944. The internal carotid fitted snugly beneath the optic nerve, and pressed it tightly against the upper edge of the optic foramen. The roof of the optic canal was removed for a distance of about one-half inch from the foramen.

On January 29th the vision in the right eye was reduced to 5/200, and the visual field showed considerable contraction in the entire periphery.

Discussion. Dr. Bernard J. Alpers stated that there was much difference of opinion in determining whether a Foster Kennedy syndrome was present in this case and whether the patient had an optic neuritis in one eye or an edema. He said he thought that this was an important point.

The aspect of greatest interest pertaining to the so-called Foster Kennedy syndrome is that there might be some clarification of the nomenclature with regard

to it. Somebody sooner or later begins to rise to a point of order with regard to nomenclature, and states that it is not the Foster Kennedy syndrome after all, and difficulties start on that score.

Another point is that thinking of the syndrome in question has become largely oriented toward diagnosis of tumor almost exclusively, so that if some other way of describing that subject could be found, such as alternating edema and atrophy, the ideas with regard to what might cause it would not become so fixed. He thought that unquestionably, in connection with this syndrome, a tumor is most frequently found in the suprasellar region, but it is not often recognized so that it may be associated with aneurysm and arteriosclerosis of the vessels of the circle of Willis. In connection with this, he said he had an interesting experience recently in a case which showed a typical Foster Kennedy syndrome with an edema in one eye and an atrophy in the other. This patient had had a head injury and some time later developed headaches and loss of vision. It was thought that he had a tumor. Visual fields showed a central scotoma in one eye, and a contraction of the visual field in the other eye. A pneumogram revealed nothing of note. Operation disclosed a very firm arachnoiditis covering the entire optic chiasm and both optic nerves. Because there was some bulging over the third ventricle, this was explored, and nothing was seen within it. In this instance it could be stated without hesitation that the Foster Kennedy syndrome was due to arachnoiditis. He believed that as more examples of this type of syndrome are seen, more causes will become evident.

Dr. W. I. Lillie showed four lantern slides, illustrating various vascular anomalies of the anterior portion of the circle of Willis producing prechiasmal syndromes.

These anomalies push the optic nerves upward and forward against the bony roof of the optic canals. This continued pressure produces the typical prechiasmal syndrome as described by Dr. Tassman. The operative procedure to relieve pressure is restricted to removing the bony roof of the optic canal, for the vascular anomaly usually prohibits any surgical interference.

Dr. Tassman, in closing said with reference to the differential diagnosis between papilledema and optic neuritis, that the patient he discussed arrived with a diagnosis of optic neuritis in the right eye. He said he never felt that the condition in the right eye was anything other than a papilledema, particularly because of the presence of good central vision. If it had been an optic neuritis the central vision would have been much less than it was found to be, practically normal.

Also, there was almost a complete absence of inflammation about the nerve head or vessels. These are the two principal distinguishing features.

George F. J. Kelly,
Clerk.

CHICAGO OPHTHALMOLOGICAL SOCIETY

February 21, 1944

Dr. Vernon M. Leech, *president*

Clinical Meeting

(Presented by the Department of Ophthalmology, University of Illinois)

Arteriovenous angioma, basilar artery

Dr. Hiram J. Smith said that F. W., a man aged 33 years, was seen on March 8, 1943, complaining of continuous persistent headaches since the summer of 1939. At that time a complete general and neurologic examination had brought

negative results. Accompanying the headaches were staggering, fainting spells, yawning, and hiccoughing, especially during the past three months; periods of blurred vision and diplopia; some nausea and vomiting but no stiffness of the neck.

On admission the patient was ambulatory, slightly dysarthric, and related his story clearly and coherently. His response was slightly sluggish, but always accurate. He gave a history of gonorrheal infection in 1938 and 1941, which was adequately treated both times. On examination a positive Romberg sign was found, with tendency to fall backward to the right; ataxic gait, hypotonicity throughout the entire left side of the body; rebound phenomenon on left side; and slight pyramidal-tract signs on the left side with increased reflexes.

Examination of the eyes showed slight hypesthesia of the corneal reflex of the right eye and bilateral papilledema with hemorrhages of the retinal type. There was questionable slight lower facial weakness on the left side, and an auscultatory bruit over the suboccipital region bilaterally, slightly more pronounced on the left side, and tenderness over the left suboccipital region. Caloric tests were negative.

On March 11, 1943, a suboccipital craniectomy and exploration of the posterior fossa were done, at which time it was found that there was a subdural clot, but this could not be definitely localized. Many large vessels were present, which seemed to be "hemangioma-bound." The pressure remained up in spite of repeated spinal taps, producing xanthochromic fluid and increased spinal-fluid proteins. Deep X-ray therapy procured no improvement. Subsequent ventriculoencephalography revealed considerable dilation in the ventricles and some air in the cisterna magna. There was communication with the lumbar space.

A needle was placed in the third ventricle for eight days, followed by a draining catheter between the posterior end of the third ventricle and the cisterna ambiens. Recovery was uneventful and the pressure remained low.

Because of the complaint of poor vision, the patient was referred to the eye department on January 13, 1944. He stated that he had to move his head to see clearly. On examination no pathologic findings were revealed. Visual fields showed only slight constriction for red, not characteristic of any lesion. Under homatropine, a weak compound hyperopic correction did not improve his vision, which was R.E. 1.0−3; L.E. 1.0−2.

Surgical restoration of socket

Dr. Carl Apple presented M. H. W., who was seen for the first time in January, 1935, when she was 31 years old. Her right eye had been enucleated at the age of five years and she had worn a prosthesis since that time. The socket was beginning to contract and the prosthesis did not fit. During 1935 the following procedures were carried out: canthoplasty; plastic surgery, incision of the conjunctiva on two occasions; implantation of dental molding compound; excision of scar tissue followed by dermal graft; and cauterization of proliferating conjunctival tissue by diathermy.

In 1936, the patient had difficulty in inserting the prosthesis and exuberant hair was removed from the socket and exuberant granulation from the upper lid, as well as proliferating conjunctiva from the upper tarsal border. Electrolysis was done on the hair in the socket.

In 1938, a dermal graft was excised and a mucous graft, 2 by 3 cm., was taken from the lower lip, placed in the socket, and held by a pressure bandage. This was followed by granulation tissue filling in the socket. During 1939 the socket was very painful with progressive shrinking

and purulent discharge, and by 1940, adhesions of lower and upper lids had completely obliterated the socket.

Further surgery was impossible at the time because of the patient's pregnancy, but in October, 1943, the socket was restored according to the Wheeler technique. The graft was taken from the inner aspect of the thigh with a Pladget dermatome. The mold was made with dental compound.

Chronic ophthalmoplegia externa, inflammatory

Dr. Roosevelt Brooks presented R. H., a girl aged six years, who was seen on January 11, 1944, with a complaint of drooping of the upper lids for three years, also tilting of the head backward. Shortly after an attack of whooping cough at the age of three years, the lid of the left eye began to droop, and six months later the lid of the right eye became affected.

The vision was R.E. 0.3; L.E. 0.1. The palpebral fissures were about one-third normal size. No movement of the lids upward was possible. There was apparent paralysis of all extraocular muscles; only slight twitching movements of the eyeballs were obtained. The right eye appeared to be almost straight in the primary position and the left diverged about 25 degrees. The pupils reacted to strong light. The discs and tension were normal.

Refraction under atropine revealed: R.E. −0.75D. sph. ⌯ +1.50D. cyl. ax. 90°, vision 0.3; L.E. −1.25D. sph. ⌯ +1.75D. cyl. ax. 90°, vision 0.1. Both eyes appeared to diverge. The visual fields were normal. There were no other neurologic findings.

Fagin, in his classification of causes of ophthalmoplegia externa, stated that meningitis secondary to an acute infectious disease develops and affects the nuclei in the floor of the fourth ventricle. Oppenheimer stated that most cases of chronic ophthalmoplegia represent prodromata or local manifestations of central-nervous-system disorders, such as tabes dorsalis, general paresis, and multiple sclerosis.

Congenital ectopia lentis, bilateral

Dr. M. H. Cutler presented C. K., a 28-year-old white man, who stated that he had had poor vision since infancy. He had worn glasses since childhood, had had frequent headaches and persistent diplopia. A younger sister, it was said, had the same ocular disturbances.

The vision was R.E. 2/200, with correction 0.4+2; L.E. 1/200, with correction 0.4−1. In testing the near point, the left eye diverged. The lenses were displaced medially in both eyes. Ophthalmodiaphanoscopy revealed a picturesque halo of both lens peripheries. Iridodonesis and tremulous lenses were present. On slitlamp microscopy of the left eye, a thin, threadlike opacity in the anterior cornea was seen to arch from the 3- to the 9-o'clock position across the width of the cornea. There was prolapse of the anterior vitreous membrane against the endothelial surface of the cornea. The zonular fibers were greatly elongated and stretched, and laterally the anterior portion of the vitreous was readily discerned. The left eye was similar except for the corneal finding. Ophthalmoscopy showed a normal fundus of dimensions seen in aphakia.

Retinitis pigmentosa, or secondary pigmentary degeneration of the retina

Dr. Roy O. Riser presented N. E., a Negro, aged 29 years, who complained of failing vision for 15 years, although he was able to finish high school.

The vision was R.E., 0.8; L.E., 1.0. Refraction revealed emmetropia. The visual fields showed tubular vision; the diameter of the field of the right eye was

15 degrees, that of the left 20 degrees. No color field was obtainable. He had an intermittent fine nystagmus. The lenses were normal, the pupils reacted to light and accommodation. Both optic discs were very white. All the retinal arteries were thin white cords. The retinal veins were attenuated but patent. The maculas were clear, but starting within 1 disc diameter of the maculas and the discs were heavy clumps of pigment in bone-corpuscle pattern. This pigmentation did not extend beyond the equatorial zone but there was no peripheral field of vision.

Although all available tests had been made no trace of a contributing disease had been found.

Scientific program

Notes on an operation for glaucoma

Dr. Robert J. Masters presented a paper on this subject which has been published in this Journal (1944, v. 27, Dec., p. 1371).

Discussion. Dr. Earle B. Fowler stated that Dr. Masters stressed two points well worth consideration; the scratch incision, and the freeing of adhesions between iris and cornea.

The root iridectomy dates back to Graefe's article in 1857. Few therapeutic measures have remained permanent over so long a period of years. Dr. Masters's operation assures a basal iridectomy; possibly he tears the root free in some cases, producing a small localized iridodialysis before cutting, a procedure recommended by Török and several others. The scratch incision can be so accurately placed as to make this complete freeing of the root a certainty.

The scratch incision was described by Elschnig under the name sclerectomia, suggested by Salzmann. Homer described it under the name iridectomy ab externo. The procedure can be carried out with almost any instrument, even a rigidly held needle, and is the safest manner of opening the anterior chamber when that chamber is shallow. The wound gaps advantageously.

As to freeing the adhesions, Jervey found that they could be broken to an appreciable distance beyond each end of the wound. He even used a small curette to remove the adherent iris tissue from the pectinate ligament. Dr. Masters, in observing his cases, may be able to see just how far he has freed adhesions; as he sweeps the spatula to the side he may not produce separation of the ciliary body from the sclera, but may, with a blunt instrument, open the spaces of the ligament as Barkan does with a sharp one.

Dr. Hiram J. Smith said he had started using this technique in 1923 and found it worked very well. In making the incision through the sclera by scratch method, as described by Dr. Masters, it is helpful to watch for the dark color of the ciliary tissue, and thus avoid breaking through or penetrating the uveal tissue.

While he had performed a number of these operations, his results were not reported because Holth of Oslo came out with an article on the same surgical procedure about 1925, before his own series was ready to be reported. He had combined cyclodialysis, sclerectomy, and peripheral iridotomy. Sclerectomy was at first performed with a cataract knife, later more easily with a scleral punch forceps. Holth showed why this type of operation was successful. He recovered eyes *post mortem* from patients who had had the operation, and showed on section that the edges of the sclera became epithelialized from the uveal tissue and the opening therefore did not close. This type of operation seldom has to be repeated, but does provide permanent drainage.

Dr. Samuel J. Meyer stated that these

operations for glaucoma always present several factors for consideration when a combination of cyclodialysis and iridectomy is performed, in that two operations are performed at one time. Following Wheeler's advice to make a cyclodialysis at 90 degrees and an iridectomy at 60 or 120 degrees, he had tried about a dozen, but had trouble in making a keratome incision because the eye got too soft following the first part of the procedure. Success of the operation depends upon the location of peripheral anterior synechiae. If a gonioscopic examination was done and it was found where peripheral anterior synechiae were, surgical procedure could be avoided in these areas and better results obtained.

He asked the incidence of cataracts in Dr. Masters's series. They are sometimes unavoidable in glaucoma surgery, and he wondered what chance there was of injuring the lens following such a small incision with the insertion of iris forceps. Also, in these aphakic eyes, was there loss of vitreous at the time of operation? It has been thought that cyclodialysis is indicated in such cases because it can be done with the least trauma. Are the results in acute congestive glaucoma as good as in the noncongestive or chronic simple type?

Dr. Thomas D. Allen said that the insidious hypertension which so frequently follows cataract surgery is, as Dr. Masters has recalled, often found early only by frequent postoperative examination of aphakic eyes for at least two years. In the examination not only the trial case, slit-lamp, tonometer, and gonioscope must be used, but repeated visual-field studies should be made, especially the central fields on a tangent screen. By using the gonioscope critically, the results of the surgical technique can be studied. Dr. Masters emphasized the position of the limbal incision so placed that it will enter the chamber immediately in front of the iris in the area of the canal of Schlemm. When any instrumentation is done in the chamber, one must be careful of the endothelium to avoid peripheral adhesions which may render surgery futile. As in all eye surgery, the less trauma to the tissues the better the surgical result. This should be emphasized.

Dr. Masters also stressed the importance of massage following glaucoma surgery, to keep open the filtering passageways to the episcleral spaces and avoid a cystoid bleb.

There is a question as to whether there may not be injury to Descemet's membrane and the endothelium in Dr. Masters's operation. If this occurs, is air injected into the chamber just as the toilet of the wound is finished, to keep the iris away from the cornea until the endothelium re-forms? A small incision is better than one that is too large, but too small an incision may interfere with accurate manipulation of the tissues.

Dr. Robert Masters, in closing, said that with an iridencleisis to aid in the establishment of drainage, as mentioned by Dr. Fowler, more is accomplished than by freeing only a small segment of the chamber angle as with an iridectomy. In some of these eyes examined gonioscopically it has been apparent that not only an iridectomy but an iridencleisis had been accomplished, because there was some iris tissue in the wound; therefore a doorjamb effect had been achieved with only a peripheral section of iris at the edge of the coloboma. However, an iridencleisis may be satisfactorily accomplished through the scratch-incision approach, as described.

With reference to cyclodialysis, he said he believed that in aphakic eyes it would be better not to make the type of ap-

proach he had described, requiring as many as three operations to bring and keep the tension down, but rather to perform the classical cyclodialysis operation.

Dr. Fowler mentioned freeing the angle by a spatula. He had entered the anterior chamber angle with the spatula with the intention of breaking up the meshwork of the iris angle; however, it appears that the meshwork probably heals together and the result is not permanent. He thanked Dr. Smith for mentioning the modification of this operation. The difficulty of accomplishing the keratome incision is the reason for the scratch incision. In two eyes there were subsequent cataracts which possibly could be blamed on the procedure. He had endeavored to hug the inside of the sclera and keep between the sclera and the ciliary body, and between the cornea and iris, thus avoiding injury to the lens. This, in turn, leads to the danger Dr. Allen mentioned, of traumatizing Descemet's membrane. Gonioscopic examinations have disclosed such trauma in two eyes recently observed, although the function of the eyes did not seem to be disturbed.

In acute congestive glaucoma and chronic glaucoma the relative results and failures have been approximately the same. He had had to repeat them on both types, and the reason could probably be explained by examination of the chamber angle, in that the first operation did not open enough chamber-angle circumference.

The time when finger massage is begun depends more or less on tenderness of the eye. He said he had not used air injections although it certainly is rational. The small scleral incision may be due to timidity. He made it longer when he found he could not easily grasp the iris.

THE CLINICAL SIGNIFICANCE OF THE pH OF SUPERFICIAL MUCOUS MEMBRANES OF THE HEAD

DR. NOAH D. FABRICANT presented a paper on this subject.

Discussion. Dr. Arlington C. Krause said that the first paper on the subject of Dr. Fabricant's research was published in 1791. Up to the present time 107 available primary papers have been published on human conjunctival fluids; of these, many are concerned with the pH of conjunctival fluids.

The pH of the fluid on the mucous membranes of the normal eye is unknown. The mucus of the conjunctiva is acid. The amount of secretion of the tear glands is apparently just sufficient to keep the conjunctiva moist but the pH of that unknown amount of tears is questionable; this is particularly true of the pre-tearing baby and of the xerotic senile. The normal tears have a pH around 7.3, varying from 7.2 to 7.5 in adults. The effect of pH on lysozyme of the tears, the enzyme which splits mucus and breaks up mucus-bearing bacteria has not been studied. Psychic tears tend to become more alkaline. The Japanese stressed the hardening effect of alkaline tears on meibomian infarcts.

The pH of the conjunctival fluids has a bearing on ocular disease. Purulent conjunctival secretions are usually acid; that is, they have a pH below 7. The bacteria and leukocytes form acid rapidly and lower the pH of the fluids.

Normally tears contain little or no glucose unless the blood sugar is high. In patients suffering from diabetes and after ingestion of much sugar, glucose is present, and is an excellent medium for purulent bacteria and for acid production. Many of the enzymes in dead leukocytes and bacteria are mainly active in acid media. Certain types of erosions may be explained on this basis.

The pH of fluids applied to the conjunctiva is important in many ways. The pH of solutions of drugs, particularly alkaloids, affect the absorption and solubility of the drug; many specific factors other than pH enter here, however. Ionized drugs may be driven into the eye. One drug is penicillin, which is acid. With a direct current, the hydrogen ion goes to the cathode and acid ion to the anode. By placing the cathode over the cornea and the anode over the neck the acid ion or penicillin may be driven into the eye to give a high concentration. The effect of extremely high or low pH, as in alkaline and acid burns, may be great progressive damage; hydrofluoric and iodoacetic acids are examples of extremely toxic acids.

The pH of conjunctival fluids is related to the use of contact glasses. In general, slightly alkaline solutions are most comfortable to the cornea and conjunctiva. Clouding of the corneal fluid is affected by the instability of the patient's tissues, loss of carbon dioxide, precipitation of phosphate and mucus, growth of bacteria, irritation of epithelium and formation of mucus, and changes in the tonicity and osmotic properties of the fluid. The contact fluid may be osmotic and not isotonic with the cornea. The pH is only one of the factors involved in these changes. The pH of the conjunctival fluids is just a part of the chemistry of tears, mucus, and Harderian, meibomian, and other glands.

The field of investigation on the surface fluids of the eye is wide open. The work is not involved and the results will lead to better treatment of external ocular diseases.

Robert Von der Heydt.

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LOCAL OPTION IN OPHTHALMO-OPTOMETRIC RELATIONS

One fact stands out clearly in the confusing ophthalmo-optometric problem, and that is that ophthalmologists have never been able to find a satisfactory solution. This is well illustrated by the actions of the ophthalmic Section of the American Medical Association at the business sessions of which diametrically opposite resolutions have been passed within one year's time. Apparently no general agreement is possible. The actions taken have been at meetings attended by less than 10 percent of the membership of the Section and seem to have been colored considerably by the locale from which the audience has been drawn and are not surely representative of the desires of a majority of the entire group.

The trustees of the American Medical Association recognized the apparent inability of the Section to solve the problem and appointed a committee specifically to consider certain questions asked by a national association of optometrists. This committee, realizing the complexity of the problem and the misunderstandings certain to ensue from correspondence without direct contacts at round-table discussions with representatives of the optometrists, reported to the trustees

that in their opinion discussions of the subject would be futile unless they were permitted to deal directly with the optometrists. The trustees, doubtless influenced by the resolutions of the Section in regard to these matters, were unwilling to give this permission and so disbanded the committee at its own request.

Dr. Conrad Berens, in his Chairman's Address to the Section at the meeting in 1944, made the suggestion that the problem could best be handled by turning the matter over to the individual states to let each decide how its ophthalmologists chose to handle this touchy question. This seems like a sound suggestion, because the problem very definitely varies in different parts of the country and because adequate authority is vested in state organizations by the American Medical Association for such action. This could then be done in a manner acceptable to the ophthalmologists in each locality.

It seems obvious that optometrists will continue to perform a large percentage of the refractions in America and will always be interested in matters that concern ophthalmologists also. It is evident that the better educated the optometrist the more capable will he be of performing well his functions as a refractionist. The standards of optometry have been continually raised in the past two or three decades and there is every indication that the leaders in this group will consistently strive for further education for optometrists. That this calling has many in its ranks who attempt to perform functions far exceeding their training is undoubtedly true. Some of them attempt to eliminate the ophthalmologist from the medical picture by referring patients directly to internists, and are actively hostile to ophthalmologists and in many ways offend the ideals of this group, but this seems to be particularly prevalent in some sections of the country, whereas in others the relationship of the two groups is satisfactory. In the Armed Forces, both in the Army and in the Navy, ophthalmologists and optometrists have worked together to the satisfaction of both. Many of the writer's former students have been closely associated with optometrists in their work in World War II and have written of cordial coöperation by them, and in many instances have expressed praise for their excellent work. It would seem a pity not to take advantage of this friendly association in arriving at a better understanding between the two groups in general.

If a resolution were passed by the Section, as suggested by Dr. Berens, referring the matter back to the individual states, undoubtedly there would be some states in which regulations liberalizing ophthalmo-optometric relationships would be passed and in which ophthalmologists would be allowed to give courses in medical subjects to groups of optometrists and in schools of optometry (as has been done repeatedly despite the rules to the contrary that have existed for many years). On the other hand, there would be localities in which the most stringent restrictions would be passed, and many states in which no action would be taken at all and the matter allowed to rest as it now is. The writer has had a satisfactory association with optometrists serving as technicians in aniseikonia for many years and during the past year in a research project on the training of visual skills in an attempt to improve myopia undertaken jointly with optometrists because it was thought that this idea, sponsored largely by optometrists, could best be evaluated by working with them. A report on this research will soon be available to the profession.

It is true that the optometric background has not been comparable with that of ophthalmologists and that there have

been and still are optometrists who are not in sympathy with their leaders who have striven and are still striving for improvements, but no one who has studied the subject even superficially can doubt that much progress for betterment has been made in the past quarter century. Nor can anyone who has had occasion to meet and confer with the best men in optometry fail to appreciate their earnest purpose.

The writer would be in favor of a resolution turning the entire matter back to the state medical organizations, as he believes that more ophthalmologists would come nearer having the type of relationships with optometrists that they desire through local rules than by any general ruling from the American Medical Association. The writer hopes that the resolution will be presented and can be made available for study by the membership of the Section sufficiently in advance of the next meeting so that members can inform themselves on the matter and express their desires by their votes on the resolution. He would also suggest a poll of the membership of the Section on the resolution before the meeting to determine the reaction of the entire membership rather than that alone of the small percentage that will attend any business session.

Lawrence T. Post.

THE NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

The average citizen has little personal contact with the misery which exists in his vicinity. Misery, except of the more or less professional variety which in more peaceful days was on display in various European countries, tends to hide itself. The most unfortunate types of blindness are seldom conspicuous to the public eye.

Financial aid for the unfortunate is not all that is required. Many state and municipal agencies exist for this purpose. But voluntary organizations play an important part in arousing the public conscience, not merely to the existence of misfortune but to the need for preventing its increase, and to those educational methods which may improve the daily living conditions of the blind and others who for one reason or another are not in possession of normal faculties.

The blind especially need guidance and education as to ways in which their lives may be made to experience the fulness of interest and activity enjoyed by the normal citizen. In stimulating public interest as to these possibilities, national organizations of a voluntary character have done much. In the United States, especially valuable as regards the function of vision has been the National Society for the Prevention of Blindness.

This Society was founded by a small group thirty years ago in New York City as an expansion of the New York State Committee for the Prevention of Blindness. It now counts a membership of thirty thousand. It undertakes a considerable variety of activities, some related to the actual prevention of blindness, others concerned with the detection of defects whose recognition may lead to remedial action.

When the Society was founded, its most important immediate aim was to reduce the incidence of ophthalmia neonatorum, which was then a major cause of blindness among children admitted to schools and institutions for the blind in the United States. The number of such children thus disabled has now been reduced by 75 percent. Thirty years ago there were only a few sight-saving classes: the number of these has grown to 613. Partly as the result of the activities of the National Society for the Pre-

vention of Blindness, there has been great multiplication and improvement in industrial programs for the conservation of vision.

In the past few years the Society has interested itself especially, not only in the protection, but also in the more effective utilization, of sight in industry; and in the control of glaucoma by early diagnosis, by determination of the best methods of treatment, and by efficient follow-up of patients in the public clinics.

The war has brought its special developments in the activities of the Society, which was called upon to participate in the War Production Board's drive for speeding up production through improvement of visual conditions in the war industries. In this connection the Society prepared, and has circulated to 7,500 industrial plants, the "Manual and Appraisal Form on Conservation and Utilization of Eyesight in Industry."

As regards the purposes expressed in the title of that form, much remains to be accomplished. Information so far furnished on the basis of the form indicates that only 61 percent of the plants make the pre-placement tests necessary for correct job assignment; that more than 75 percent of the plants in which the tests are made do not have the testing done under the direction of an eye specialist; that more than 85 percent of the plants fail to make a periodical recheck of the vision of their employees; that more than 80 percent fail to recheck the vision of workers who are exposed to special hazards; that 92 percent neglect to recheck vision of employees who show poor production records; that 83 percent neglect to recheck vision of workers involved in accidents; and that 73 percent neglect to recheck employees whose original visual test indicated a need for follow-up.

The National Society for the Prevention of Blindness has conducted, or has coöperated in conducting, several instruction courses. One of these was aimed at the training of additional industrial ophthalmologists; another, held in connection with the annual meeting of the American Public Health Association, was in the nature of a conference of nursing consultants, supervisors, and instructors whose duties had to do with the nursing care of eyes in industry.

The Society recognizes the need for further development of the program for sight-testing, not only in industry but in the schools. The present machinery for investigating the vision of school children and older children is usually inadequate for the detection of such defects as do not produce marked visual deficiency. Thus a child or student may have a disturbing amount of hyperopia or astigmatism, or significant inequalities of refraction as between the two eyes, without being recorded as in need of professional attention. Only in limited areas of the country has this fact been recognized by the adoption of special training for those engaged in making the necessary school examinations, and in provision of equipment more completely suited to the purpose than the mere recording of uncorrected vision of the Snellen chart.

The Society's outstanding achievements for the prevention of blindness and conservation of vision have been rendered possible by the loyal work of officers and directors and an executive staff which labors with zeal and understanding toward fulfillment of the Society's objectives. The Society's Executive Director, Mrs. Eleanor Brown Merrill, last year became President of the National Health Council; and a volume by the Society's Associate Director, Mrs. Winifred Hathaway, entitled "Education and Health of the Partially Seeing Child," has gone into a second edition in the

United States, while a separate edition of this work has been published in England. Miss Isobel Janowich is the earnest and capable editor of the Society's monthly publication "The Sight-Saving Review."

W. H. Crisp.

CORRESPONDENCE

THE TRACHOMA INCLUSION BODY

April 29, 1945

The Editor,
American Journal of Ophthalmology:

The important article by Arnold Loewenstein entitled "Trachoma virus and the morphology of inclusion bodies," which appeared in the March, 1945 issue of your Journal, is of much interest. In my opinion, however, it gives the reader the impression, through the omission of certain essential references, that much less is known about the trachoma inclusion body than actually is the case.

Professor Loewenstein fails to mention that trachoma virus is a member of the psittacosis, lymphogranuloma-venereum group of viruses, a group about which much is known, particularly as to the elementary-body–initial-body cycle of morphologic variation which is characteristic only of the inclusions of this group. Tissue-culture studies of psittacosis and lymphogranuloma venereum have shed much light on the inclusion bodies of this entire group, and there can be no doubt but that the initial body represents the early intracellular phase of the virus and the elementary body the late intracellular phase.

In his opening paragraph Professor Loewenstein states that "inclusion bodies that are microscopically indistinguishable from those found in trachoma are found in other conjunctival diseases." This is certainly misleading, since indistinguishable inclusions are found only in inclusion conjunctivitis, a related virus disease which is also a member of the psittacosis, lymphogranuloma-venereum group. Professor Loewenstein's comment may be referable to the early confusion over inclusion conjunctivitis which was formerly considered as three separate diseases (inclusion blennorrhea, swimming-bath conjunctivitis, and acute follicular conjunctivitis with inclusions) but is now known to be one etiologic entity, or possibly to the reported findings, now known to be false, of similar inclusions in vernal catarrh and in hog cholera.

Professor Loewenstein rightly states that "trachoma is not a disease restricted to the epithelium" but fails to consider the probability that the virus itself remains strictly epithelial. As had previously been done by others, the writer repeatedly inoculated baboons, later proved susceptible by epithelial inoculation, through the skin of the lids, placing the virus subconjunctivally in the fornices. Infection has never been obtained by this route. The writer has also searched repeatedly for inclusions in the subepithelial tissues and has never been able to find them. These findings are in accord with the theory that trachoma virus is strictly epitheliotropic and produces subepithelial changes by the liberation of soluble toxic substances. This theory is strengthened by the fact that soluble toxic products have been demonstrated for the related viruses of lymphogranuloma venereum, meningopneumonitis, and mouse pneumonitis by Rake and his associates (Geoffrey Rake and Helen P. Jones. Jour. Exper. Med., 1944, v. 79, p. 463).

No consideration of the trachoma inclusion body is complete without mention of the very important work of Rice (Amer. Jour. Ophth., 1936, v. 19, p. 1)

who demonstrated the presence of a carbohydrate matrix for the trachoma inclusion body. This matrix is always present in the mature inclusion body and its demonstration should always be a part of any study of inclusions of uncertain nature. The writer has demonstrated to his satisfaction that no carbohydrate-containing inclusions are present in the subepithelial tissues in trachoma.

The various studies which have been made of the closely related virus-disease inclusion conjunctivitis also shed much light on the trachoma inclusion, since in this harmless disease many human inoculations have been possible. Thus in this disease it was demonstrated by the writer that the inclusion body requires about 48 hours for its intracellular development, a finding which is identical with the finding in psittacosis and which is probably applicable to the inclusions of the entire roup.

Most of the references discussed in this letter may be found in my review, "Viruses and virus diseases of the eye," which appeared in the Archives of Ophthalmology, 1943, v. 29, March, pp. 488-508, and 1943, v. 29, April, pp. 635-661.

(Signed)
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Discussion of Hering on visual direction

April 25, 1945

Editor,
American Journal of Ophthalmology:

The teachings of Hering and his school have been so often misrepresented in the recent literature dealing with binocular vision that one gains the impression that the majority of authors have not obtained first-hand information from the sources.

In an article entitled "A contribution to the theory of binocular vision supported by three cases of latent nystagmus," which appeared in the April, 1945 issue of the American Journal of Ophthalmology, Dr. Adolph Posner gives a brief account of Hering's theory. He states that, according to this theory, in binocular vision "the ((foveal) image is projected along the visual axis of a hypothetical, cyclopean eye, or binoculus," and that "in general, any pair of points on the two retinas that are projected in space along the same line, are corresponding points."

Neither statement is correct. According to Hering, each retinal element possesses an inherent relative directional spatial value. Experimental evidence has confirmed time and again the stability of these directional retinal spatial values. Corresponding retinal elements have the same relative spatial value, and object points imaged on them are seen in the same subjective visual direction. Nowhere does Hering state that retinal images, let alone retinal points, are projected along any axis. In fact, Hering's pupil, Hofmann, is quite specific on this point. He says (in *"Die Lehre vom Raumsinn,"* in Graefe-Saemisch's Handbuch der gesamten Augenheilkunde, ed. 2, Berlin, 1925, v. III, chapter XIII, p. 236): "The fact must be especially emphasized that the theory of the visual directions does not imply that the retinal images are 'projected outward' from the median imaginary eye along the visual directions. The opinion is derived, just as the projection theory in general, from the erroneous assumption that the retinal images are first presented to the mind and that they are then somehow transposed into space. Actually, most people have no inkling that there is such a thing as a

retinal image. Not these images, but the sensations in subjective space are the primary experience. The visual directions are only a subsequent intellectual reconstruction of this immediate experience."

Hering's teachings are not so much a theory as a description and interpretation of phenomena observed under rigorous experimental conditions by means of methods which Tschermak has termed methods of exact subjectivism. It is strange to note that these most exact methods of observation are so often dismissed as "introspective" or "subjective" and therefore affected with an "inherent weakness" (Posner).

The fact that some objective points, though they may be widely separated in objective space, appear in the same subjective visual direction can be verified experimentally without any trouble. In order to be so seen, the object points have to be imaged on specified retinal elements which were named corresponding retinal elements. It was thus concluded and defined that corresponding retinal elements have a common subjective visual direction. How corresponding retinal points come to have a common subjective visual direction is not explained by the theory. To be sure, it is assumed that there is not only simultaneous stimulation, but also simultaneous perception in the act of fusion, but *in principle* there could also be a rapid alternation or replacement (Verhoeff). Hering himself has expressed the idea that a rapid alternation may be the cause for the establishment of an anomalous correspondence; that is, the establishment of a common visual direction between *de norma* disparate points (Deutsch. Arch. f. klin. Med., 1899, v. 64, p. 17).

In any event, Dr. Posner's interesting observation regarding the stabilizing influence of the amblyopic eye on the fixating eye does not in itself support either Hering's teachings or Verhoeff's replacement theory. If Dr. Posner's explanation is correct that this stabilizing influence is a function of the peripheral retina (that is, presumably a peripheral binocular cooperation or fusion), then it can be interpreted in terms of any fusion theory one chooses to adopt.

It is, finally, noteworthy that Dr. Posner has observed in patients with anomalous correspondence a marked facility to judge depth binocularly as compared with monocular vision. This is not in accord with the general experience that patients with anomalous correspondence are unable to pass standard tests for stereopsis.

(Signed)
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ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

1

GENERAL METHODS OF DIAGNOSIS

Eggers, Harry. **Estimation of uncorrected visual acuity in malingerers.** Arch. of Ophth., 1945, v. 33, Jan., pp. 23-28.

Careful retinoscopic study should be made under complete cycloplegia. Slitlamp and ophthalmoscopic examinations should rule out opacities in the media and lesions in the fundi. Neurologic conditions that cause central scotoma are not detectable with the ophthalmoscope. The history, the circumstances surrounding the case, and the perimetric and tangent-screen plottings at varying distances will usually all aid in establishing a diagnosis of retrobulbar neuritis, toxic amblyopia, or interference with the visual pathways. In a normal eye, the uncorrected visual acuity can be estimated accurately if the approximate refractive error is known. The author produces tables which represent correlations and deductions made on the basis of over 6,000 refractions on young adults of both sexes, who had no reason for withholding the truth. Eyes with astigmatism of identical amounts show small, but definite, variations in uncorrected visual acuity depending on the position of the axis. Simple myopic and simple hypermetropic astigmatism of the same amount are associated with practically identical decreases of visual acuity. A certain correspondence exists between cylindric and spherical corrections for myopia. (3 tables.)

R. W. Danielson.

Somberg, H. M., and Ingham, H. V. **A simple aphasia study.** New York State Jour. Med., 1944, v. 44, May, p. 1126.

The authors describe the plan as used by Foster Kennedy on the Neurological service at Bellevue Hospital for standard examination of an aphasic patient. The visual portion of the test includes the usual estimate of vision and visual fields. Recognition of objects is tested by first naming objects shown, matching objects with a written list, and recognition of colors.

Recognition of symbols includes first letters, then words and sentences. Motor function is tested by reading own writing, then by ability to cut out letters from a blank sheet. Copying is tested by writing first spoken and then written sentences. The form chart is given in the article.

Owen C. Dickson.

Williamson, W. P. **Afterimage perimetry.** Arch. of Ophth., 1945, v. 33, Jan., pp. 40-42.

The phenomenon of afterimage has apparently not been utilized as a means of perimetry. By a technique here described the author tested the possibility that in a patient with a lesion of the central optic pathways, the afterimage might show a defect corresponding to the site and size of the area of damage.

He claims the following and other advantages for this method: It is not tiring to the patient or to the examiner. The patient is unable to look away from the fixation point, since the afterimage moves simultaneously with any shift of the eye. With a hand lamp the method is readily adaptable to the bed patient, who sees the afterimages on the ceiling. With a simple design of an object in each quadrant, the method can be utilized for children. It is time-saving, and can be utilized in routine examinations for the armed services. However, the method reveals only absolute field defects. (4 figures.)

R. W. Danielson.

2

THERAPEUTICS AND OPERATIONS

Dunnington, J. H., and Von Sallman, L. **Penicillin therapy in ophthalmology.** Arch. of Ophth., 1944, v. 32, Nov., pp. 353-361; also Trans. Amer. Ophth. Soc., 1944, v. 42.

The authors report in detail as to the therapeutic effectiveness of penicillin in diseases affecting the eye. Mannitol-positive strains of Staphylococcus aureus were injected into a series of rabbit eyes. One eye was treated in various ways with penicillin; the second eye was used as a control.

Corneal baths were found to be of little avail; iontophoretic applications of penicillin to the cornea were beneficial if started six hours after inoculation, the benefit varying directly with the shortness of time elapsing between inoculation and treatment. Intralenticular and intravitreal injections were very effective in arresting endophthalmic disease processes. In the rabbit eyes, there was a certain amount of chemical or mechanical damage to the retina and lens. However, the authors assume that the relatively greater size of the human eye will protect it from such damage since the point of the needle can be placed at a greater distance from those structures. Several very interesting case reports are included. (References, 1 illustration.)

R. W. Danielson.

Knapp, F. N. **Treatment of ocular tuberculosis.** Trans. Amer. Ophth. Soc., 1943, v. 41, pp. 442-489.

The author presents an excellent review of the literature on ocular tuberculosis for the past ten years, covering tuberculinotherapy, hemotherapy, chrysotherapy, phototherapy, radiotherapy, climatotherapy, and dietotherapy. He cites 11 cases of ocular tuberculosis receiving a variety of therapy. His findings add to the preponderance of evidence in favor of tuberculinotherapy and dietotherapy. (4 illustrations, bibliography.)

Carl D. F. Jensen.

Leopold, I. H., and LaMotte, W. O. **Penetration of penicillin in rabbit eyes**

with normal, inflamed, and abraded corneas. Arch. of Ophth., 1945, v. 33, Jan., pp. 43-46.

The authors used rabbit eyes. The penicillin in solution consisted of 500 Oxford units of the sodium salt per c.c. of isotonic solution of sodium chloride. Penicillin ointment was prepared with a polyethylene glycol (Carbowax) base. The concentration of penicillin in the ointment was 500 Oxford units per gram of base. Four drops of the penicillin solution or 0.2 gm. of penicillin ointment was applied to the conjunctival sac once, and aqueous humor was withdrawn 15 minutes, 45 minutes, or one hour and 45 minutes after the instillation.

The authors review the literature in which the opinion has been expressed that damage to corneal epithelium by high concentrations of penicillin in solution may account for high concentration of penicillin in the aqueous humor after the corneal-bath technique. The corneas were abraded in these experiments not only to measure the absorbability of penicillin under such conditions, but also to test the influence of penicillin on the rate of regeneration of corneal epithelium.

The authors' conclusions follow: Penicillin in solution or ointment fails to penetrate into the aqueous humor of the normal rabbit eye after one local instillation, but penetrates readily in the presence of corneal abrasion or ulcer.

The concentrations thus obtained exceed the probable therapeutic level. It is not necessary to resort to iontophoresis, the corneal bath technique, or subconjunctival injection to obtain effective concentrations in eyes with infected corneal ulcer or corneal abrasions. The solution or ointment described needs to be used only once every two hours in the cul-de-sac to maintain high concentration in the aqueous humor. Repeated applications of the solution do not significantly retard regeneration of corneal epithelium. (3 tables, references.) R. W. Danielson.

Malbran, Jorge. **Some therapeutic principles and rules in ophthalmology.** Ophth. Ibero Amer., 1944, v. 6, no. 1, pp. 1-13 (in Spanish), and pp. 13-23 (in English).

This is a review of the literature of the last few years, and deals particularly with the following topics: vascular physiology, parasympathicomimetic drugs, sympathicomimetic drugs. References are made to a number of investigators in the United States.

W. H. Crisp.

Sertorio Senna. **Sodium nicotinate as a vasodilator in ophthalmology.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 197-198.

Sodium nicotinate was found to be superior to nicotinic acid because of its high solubility. Injections are painless and may be given subcutaneously, intramuscularly, or intravenously. Injections are followed by mild symptoms of vasodilatation. Dosage begins with 1 c.c. of a 1-percent solution, and is increased progressively until 12 to 15 doses have been given. Good results have been obtained in arresting the progress of affections of the retinal and cerebral circulation.

J. Wesley McKinney.

3

PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Ames, Adelbert, Jr. **The space eikonometer test for aniseikonia.** Amer.

Jour. Ophth., 1945, v. 28, March, pp. 248-262. (10 figures, references.)

Cushman, Beulah. **Analysis of cases of aniseikonia.** Arch. of Ophth., 1945, v. 33, Jan., pp. 9-12; also Trans. Amer. Ophth. Soc., 1944, v. 42.

The doubts set forth in an editorial by Crisp in the December, 1943, issue of the American Journal of Ophthalmology suggested the following presentation of and comments on cases of aniseikonia.

The first question was how large a proportion of the ocular difficulties apparently relieved by prescription for aniseikonia were capable of relief in another way; the second question, what proportion could have been relieved by more complete accuracy in refractive measurements without the aid of size lenses.

Since September, 1942, the present author has made the examinations for aniseikonia of the patients referred to the department of ophthalmology of the Northwestern University Medical School. A total of 117 such examinations have been made, and of this number 97 were complete enough to permit analysis. Sixty-one patients showed an appreciable amount of aniseikonia; 17 no aniseikonia; and 19 had such poor fusion that examination was impossible until after some form of muscle training. Iseikonic lenses were ordered for 24 patients, and of this number 14 stated that they had obtained complete comfort, with disappearance of their asthenopic symptoms. Three reported that the condition was improved and four noticed no improvement.

Cushman suggests that the answer to Crisp's question of how large a proportion of the ocular difficulties apparently relieved by prescriptions for aniseikonia could have been relieved if the patients had worn careful refractive corrections first is answered by the results with the patients who were made comfortable with the iseikonic lenses, since the majority of these patients had worn the same prescription for their refractive correction before size magnification was added. It is to be pointed out, also, that their muscle balance was normal or was restored to normal with simple treatment.

In answer to the second question, as to what proportion of ocular disturbances could have been relieved by greater accuracy in refractive measurements without the aid of size lenses, the corrected vision of the patients was excellent as a rule, and the refractive measurements were usually accepted; but the ocular muscle balance was frequently inadequate, and a satisfactory examination for aniseikonia was not possible until binocular fusion was improved and until it could be maintained. With improvement in the maintenance of binocular fusion, several of the patients were as comfortable without the glasses as with them. (7 tables, references.) R. W. Danielson.

Eggers, Harry. **Retinoscopy at a varying distance.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 318-319.

Fink, W. H., **Trial frame for young children.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 403-404. (One figure.)

Gallego Fernández, Antonio. **Functional significance of the visual cells.** Arch. de la Soc. Oft. Hisp-Amer., 1944, v. 4, March-April, pp. 165-175.

The perception of light with its two components, chromatic and achromatic, is a function of the photoreceptor sys-

tems or functional unities of rods and cones in relation to the neighboring elements. The different proportions in which the rods and cones are found in the various zones of the retina explain the qualitative difference between central and peripheral vision. The visual acuity is also related to the distribution of the ganglion cells. (5 figures, references.) J. Wesley McKinney.

Hardy, L. H., and Rand, G. **Elementary illumination for the ophthalmologist.** Arch. of Ophth., 1945, v. 33, Jan., pp. 1-8.

The optimum number of foot candles of illumination for gross and critical work has been a subject of heated debate. The effect of changes of illumination on ocular fatigue in the zones ordinarily encountered, that is, between 10 and 30 foot candles, is relatively unimportant. But continued use of the eyes, especially for fine work, under greatly inadequate or greatly excessive intensities will result in eyestrain and functional inefficiency.

An important factor in evaluating or prescribing lighting is the contrast involved in the work being done. High contrast means increased visibility. Contrast is frequently evaluated as percent and fitted into lighting prescriptions on that basis. For example, printer's ink reflects little (approximately 4 percent) of the light incident to it, while good white paper reflects about 80 percent of the light incident to it. The relative contrast of such ink and paper, then, is 80 percent less 4 percent, or 76/80, which corresponds to 95 percent.

Glare is a factor in faulty distribution and has been defined as useless light in the field of vision. Its importance increases as it approaches a position on the line of sight. Glare may be diffuse, specular, or direct. Diffuse glare is the type experienced outdoors from too high intensities. Specular glare is the type produced by mirrors, highly polished metal and furniture, glossy paper, and other shiny surfaces. Direct glare arises from bright objects in the field of vision, such as headlights out of doors or unshaded lamps indoors. Unpleasant effects of such sources of glare are, as already stated, directly proportional to the brilliance of the object and its proximity to the line of sight. Hence large sources of low intrinsic brilliance, achieved through "luminaire" design, diffusing glasses, or semi-indirect lighting, are according to the authors distinctly preferable to small, bright sources.

Fluorescent-tube lighting, introduced in 1938, has been growing in use and importance. But much is still to be desired, and it is too early to give an unqualified opinion. The present fluorescent tubes are too bright for comfort when unshielded, and most installations carry little or no shield. They do not, and probably cannot, be made to give the spectral curve of daylight. Fluorescent tubes are best suited for installations in large areas and are particularly useful in air-conditioned interiors because of their relatively low heat output. They should always be mounted high.

At the Knapp Memorial Laboratories, where studies on fluorescent lighting have been carried out, the authors have been inclined to explain the unpleasant effects of this type of lighting in terms of six factors: (1) flicker, either (a) total or (b) electrode; (2) spectral quality; (3) high intrinsic brightness; (4) radiation of wavelength of 312 to 313 millimicrons; (5) lag of emission in the blue-green-yellow por-

tion of the spectrum, and (6) stroboscopic effect. (2 figures, references.)

R. W. Danielson.

Harman, N. B. **Sight-saving classes.** Brit. Med. Jour., 1945, Jan. 13, p. 53.

The author commends the work of American educationists in the establishment of sight-saving classes, and relates his own early experiences in saving the sight of schoolchildren. He also discusses the progress and spread of such classes in England. The "potentialities of the school for the partially blind" lie in its ability to teach these children, mostly high myopes, to use their eyes intelligently.

Francis M. Crage.

Hecht, Selig, **Energy and vision.** Amer. Scientist, 1944, v. 32, July, p. 159.

An understanding of the amount of energy needed to see light requires a knowledge of physics, chemistry, some biology, and mathematics. After evaluating previous measurements of minimum energy necessary for vision and discussing optimum physiologic conditions, the author and his co-workers describe the technique of their measurements and offer tabulated results. The article, though rather technical, has interesting details on the physiology of vision. Frances M. Crage.

Knapp, A. A. **Eyeglasses for combat.** U. S. Naval Med. Bull., 1944, v. 43, Nov., p. 964.

The author criticizes the common belief of many that the serviceman with 20/20 vision should have no use for glasses in combat. He points out that many men are able to pass the 20/20 requirement but still request glasses for comparatively poor (20/20 or less) vision or for symptoms of asthenopia. A large percentage of ametropic service men read the 20/15 line, and a fair number read even the 20/10 line. Vision is so important in combat and a man ought to have every possible advantage over his opponent. If by wearing glasses this can be obtained the practice is justified. Likewise, if asthenopic symptoms can be avoided by proper glasses a man is more efficient visually for prolonged watch or observation periods.

Glasses are not suited for use in situations where reflection may be a factor, such as night patrols, or hand-to-hand combat. The objection based on danger to the eyes from broken spectacle glass is answered by the argument that in present warfare injuries capable of breaking spectacle glasses usually are such that like damage could be expected to the unaided eye and orbit. Glasses are contraindicated in conditions such as spray aboard ship, or in the tropics where perspiration and fogging are common. Owen C. Dickson.

Posner, Adolph. **A contribution to the theory of binocular vision supported by three cases of latent nystagmus.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 392-396. (References.)

Regan, J. J. **The goal of an eye-hygiene program for school children.** New England Jour. Med., 1944, v. 231, Oct. 5, pp. 486-490.

The cornerstone of a workable and effective eye-hygiene program rests on the understanding, especially among teachers and pupils, of the value of normal vision to the progress of health and education. The State Department of Public Health and the Department of Education should stimulate surveys by the school authorities in cities and towns and create interest in the ad-

vantages of requiring annual vision tests, with an authoritative statement regarding the importance of conducting the tests properly. An outline for teachers might be arranged, giving symptoms of eyestrain that may warrant a medical eye examination. Often a child with 20/20 vision in each eye suffers from sties, crusted red lids, watery eyes, or headaches after close work. Many of these children are farsighted, and if their accommodation is good the Snellen test will not screen them out. Such children often require glasses. A suitable committee could encourage inclusion of some simple color-perception test, especially for junior-high-school pupils who might be planning careers in art, aviation, or textile industry. Before any of these plans are undertaken it is important to record the presence or absence of normal vision in every school child. (References.)

M. Lombardo.

Sloane, A. E. **Refraction clinic.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 404-405.

Stiles, W. S. **Photometer for measuring the scotopic candlepowers of self-luminous ophthalmic test objects.** Brit. Jour. Ophth., 1944, v. 28, Dec., pp. 629-637.

A photometer is described in which the scotopic candle-powers of very feeble light sources (down to 10^{-9} candle) can be measured. The test consists of a comparison of the. candle powers of the test object and of a standard source of the same size, by a substitution method. Small spots of radium paint 2 or 3 mm. in diameter are used to plot the dark-adapted visual field and the photometer described was designed for their calibration. (2 figures, 2 tables.)

Edna M. Reynolds.

Swan, K. C., and White, N. G. **Dibutoline sulfate. (A new mydriatic and cycloplegic drug.)** Arch. of Ophth., 1945, v. 33, Jan., pp. 16-22; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1944, 94th mtg.

New mydriatic and cycloplegic drugs are needed. Recently the authors have synthesized the first substitutes for the atropine series effective on the eye. The new mydriatic and cycloplegic drugs are surface-active carbamic-acid esters of the choline type, and are therefore chemically unrelated to atropine. The ocular effects of the first of the new class of drugs have been reported previously. Herein are described the ocular pharmacologic effects and some clinical applications of dibutoline, the name chosen for the latest and most effective member of the series.

Dibutoline produces paresis of smooth muscles innervated by the parasympathetic nervous system. Its effects on the smooth muscles of the eye, therefore, simulate those of paralysis of the oculomotor nerve; that is, dibutoline produces paresis of the sphincter of the iris and the ciliary muscles. The action of dibutoline on the intraocular muscles is antagonistic to that of pilocarpine, physostigmine, acetylcholine and carbaminoylcholine.

Dibutoline has no effect on the ocular muscles innervated by the sympathetic nervous system,, that is, the smooth muscle of the lid and the dilator fibers of the iris. It does not produce widening of the palpebral fissure, which is effected by epinephrine, cocaine, and related compounds; neither does it significantly alter reactivity of the dilator fibers of the iris to electrical stimulation of the cervical sympathetic nerve or to stimulatory drugs. Mydriasis produced by the new drug, therefore, may be enhanced by administration of

epinephrine or related compounds, which act by stimulating the dilator fibers.

As a substitute for the atropine series of drugs in routine cycloplegic refraction and in internal examination of the eye, dibutoline has several advantages, notably, rapid action, a short period of visual disability, and negligible systemic effects from ocular administration. Unlike the atropine series, the new drug has equal effect on the iris and ciliary body; consequently, the size and reaction of the pupil provide a convenient indication of the degree of cycloplegia. Dibutoline has an antiseptic action which may prove advantageous in the treatment of inflammatory conditions of the anterior segment. Its duration of action is ideal for treatment of such processes; it also facilitates penetration of other drugs. It has the disadvantage that repeated instillations produce irritation of the conjunctiva and a mild, transitory, superficial punctate disturbance of the corneal epithelium. These effects are due to the surface activity of the drug. (4 figures, references.)

R. W. Danielson.

4

OCULAR MOVEMENTS

Burian, H. M. **Motility clinic. Sudden onset of concomitant convergent strasismus.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 407-410.

Davis, W. T. **Paresis of right superior oblique and of left superior rectus muscle.** Arch. of Ophth., 1944, v. 32, Nov., pp. 372-380.

Paresis of the right superior oblique muscle differs in its manifestations, the symptoms depending on whether the paresis is of recent or of late origin. Also, in the intermediate stage, when the paresis is recovering and the contractures are becoming manifest, the symptoms differ somewhat from those in the early and late stages. The most striking sign of this condition is habitual torticollis. It is present only when an oblique muscle is involved, either the superior or the inferior; it does not occur when the superior or the inferior rectus muscle is paretic. The two symptoms, torticollis and upshoot of the eye with the head tilt toward one shoulder, constitute the distinguishing feature. The torticollis is invoked by the patient to prevent diplopia.

It is interesting to note why the deviation due to paresis of the vertically acting muscle does not become noncomitant, as with paresis of the abducens nerve, for example. The influence of vertically acting muscles varies according to the position of the eyes. When the eye is abducted, it is within the field of the vertically acting rectus muscles; when the eye is adducted, it is within the field of the oblique muscles. It is apparent that the deviation due to paresis of a vertically acting muscle cannot become concomitant in the ordinary sense, since the deviation occurs only in the field of action of the oblique or the vertical rectus muscle. Consequently, it can be concomitant in these fields only.

Therapy is surgical; orthoptic training is indicated when the deformity has been surgically corrected. The first essential is a correct diagnosis; otherwise, irreparable harm may be done. With dissociated hyperphoria any surgical procedure is particularly to be avoided; in some cases this form may closely resemble the hypertropia of paresis of the superior oblique muscle,

treatment of which is purely surgical. To confuse the diagnosis of these two forms of hypertropia may be fatal to the desirable result—binocular single vision. The usual operation is myectomy of the right inferior oblique muscle.

Early and late stages of this entity are presented in detail. (One reference, 9 figures.) R. W. Danielson.

Foster, John. **Buried silk, catgut, and strabismus sutures.** Brit. Jour. Ophth., 1944, v. 28, Dec., pp. 625-629.

Clinical and experimental findings on the relative strength of buried catgut and silk strabismus-sutures are reported. The minimum safe tensile strength for a suture at the time of insertion is found to be about 30 ounces. Number 2 white braided silk and 000 catgut are probably initially unnecessarily strong, and number 0 white twisted silk is not reliable enough for deep strabismus suturing. Cotton thread is stronger than ophthalmic silk of the same diameter.

The length of sterilization up to six minutes has little effect on silk but silk sterilized in 2-percent sodium bicarbonate solution is only 97.7 percent as strong as when sterilized in distilled water. (3 tables, one comparing findings of various authors; references.)

Edna M. Reynolds.

Kaye, Herbert. **The treatment of squint in childhood.** South African Med. Jour., 1944, v. 18, Oct. 14, p. 327.

The essence of the author's conclusions after experience in the treatment of this condition is the importance of time. The earlier any procedure is begun the greater the number of successes that may be expected. Early prolonged occlusion of the good eye in the monocular types is used. The period of occlusion should be for not less than a month.

The largest group seeking advice are those patients between the ages of four and eight years. Those with small squint angles responded to stereoscopic exercise. The large-angle cases showed that effort on the stereoscope was wasted. Such cases called for very early surgery. The operative procedure usually followed was advancement of one muscle and recession of the opposing muscle. Absorbable scleral sutures were employed.

When a trial of glasses for six months, continuous occlusion, and stereoscopic exercises have failed to improve large or alternating squints, early operation is strongly recommended. After the surgical procedure, stereoscopic exercises are resumed.

Francis M. Crage.

Posner, Adolph. **A contribution to the theory of binocular vision supported by three cases of latent nystagmus.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 392-396.

Quereau, J. V., and Putnam, O. A. **Quereau-Putnam tropophorometer.** Arch. of Ophth., 1945, v. 33, Jan., pp. 28-31.

The instrument here described has been designed to measure deviations of the eyes in cases of squint and heterophoria. It will measure vertical deviations in the six cardinal directions, as well as horizontal deviations for distance and near vision. Its accuracy, especially in objective tests, is greater than that of any other method of which the authors know. (3 figures.)

R. W. Danielson.

Reid, A. C. **A simple method of dem-**

onstrating nystagmus in certain miners. Brit. Jour. Ophth., 1944, v. 28, Dec., pp. 598-599.

In order to demonstrate the cases of nystagmus which are present only in a stooping position, the author recommends the use of a concave mirror 12 cm. in diameter with a curvature of −0.75 D. The patient stoops and fixes his gaze on this mirror in the dark. When he reports that the eye movements have begun, the examiner sees the oscillations (magnified) in the mirror with the aid of a pocket torch.

Edna M. Reynolds.

Smith, H. D., and Riesenman, F. R. **Unusual forms of nystagmus.** Arch. of Ophth., 1945, v. 33, Jan., pp. 13-15.

The authors discuss several unusual and comparatively rare forms of nystagmus, and present a detailed case report. Two types of ocular nystagmus, volitional and occupational, and a form of mixed nystagmus due to compression of the upper cervical portion of the cord, are considered.

Persons with voluntary nystagmus have never had true nystagmus. The voluntary nystagmus of hysteria is jerky and irregular. With three exceptions, and excluding miners' nystagmus, a review of the literature of the past 25 years fails to reveal any case of occupational nystagmus. Occupational nystagmus results from interaction of several factors: poor and improper illumination, mechanical to-and-fro movement of the eyes incidental to the particular occupation, and retinal fatigue. (References.)

R. W. Danielson.

Sugar, H. S. **An aid in using the prism cover test in the cardinal directions of gaze.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 397-398. (2 figures, references.)

5

CONJUNCTIVA

Avtsin, A. P. **Conjunctival exanthem in spotted typhus.** Arch. of Pathology, 1943, v. 36, pp. 158-162.

The author calls attenion to a gross sign which in its characteristic form justifies the suspicion of spotted typhus even in the absence of clinical data. The characteristics are multiple red spots and dots or points, and also oblong and oval spots, the latter being particularly characteristic. The sign is particularly useful in determining whether death has taken place from this disease. (5 photomicrographs, references.) W. H. Crisp.

Beard, H. H., and Dimitry, T. J. **Some observations upon the chemical nature of the pterygium.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 303-305. (4 figures, references.)

Braley, A. E. **Epidemic keratoconjunctivitis.** Arch. of Ophth., 1945, v. 33, Jan., pp. 47-55.

In 1889 Fuchs reported 38 cases of a disease he called "superficial punctate keratitis" which occurred in epidemic form in Vienna. The keratitis was preceded by acute conjunctivitis and the disease appears to have been similar to, if not identical with, the disease now under discussion.

A number of patients have undoubtedly contracted the disease in clinics.

Two incidents are related by the author: The first involved the use of the tonometer. In the diagnosis of epidemic keratoconjunctivitis, the intraocular tension was taken to rule out the

possibility of acute glaucoma. The tonometer was then used on two other patients with chronic glaucoma, in both of whom epidemic keratoconjunctivitis developed on the fifth and sixth days respectively after the examination. Adler called the other incident to the author's attention. In two patients who were given trial fittings of contact lenses, epidemic keratoconjunctivitis developed on the fourth and sixth days respectively after the fittings.

The author injected scrapings into white mice and was able to obtain a pathogenic virus.

The clinical disease may be divided into three stages. In stage 1, the primary symptoms are those of sensation of a foreign body, with moderate itching and burning. The most striking features are edema of the upper lid, and chemosis and edema of the semilunar fold and caruncle.

The disease enters the second stage in approximately 48 hours. Large follicles and considerable subconjunctival infiltration develop, particularly in the lower lid. The follicles in the conjunctiva are large, translucent, and usually oval. During this phase there is nearly always a palpable, slightly tender preauricular lymph node, and symptoms of involvement of the upper respiratory tract are often present. Frequently small hemorrhages are seen on both the bulbar and the palpebral conjunctiva, but they are not so severe as in acute pneumococcic conjunctivitis. A pseudomembrane may develop on either the upper or lower lid.

The third stage of the disease is characterized by persistence of the follicular conjunctivitis and by development of corneal changes, which produce symptoms of photophobia and blurring of vision. Corneal opacities usually begin to form on the seventh or eighth day, typically beginning as minute, discrete subepithelial dots, occasionally so numerous that they coalesce to form a gray opacity in the superficial layers of the cornea. In spite of their numbers and their proximity, it is almost always possible with the biomicroscope to see that they are composed of discrete nebulas and that they do not all lie in the same level of the cornea.

Patients recovering from the disease have immune bodies for the virus in their serums. The sulfonamide compounds, penicillin, and probably tyrothricin have no effect on the virus. Convalescent plasma or serum, administered before the fifth day of the disease, is the treatment of choice. Corneal opacities developed in 99 percent of the patients treated symptomatically, but in only 30 percent of patients treated with convalescent plasma. (7 tables, 4 figures, including one color plate, references.) R. W. Danielson.

Gartner, Samuel. **Blood vessels of the conjunctiva.** Arch. of Ophth., 1944, v. 32, Dec., pp. 464-476.

The author used a new technique of high speed photography to study the blood vessels of the conjunctiva. A new light source producing flashes of approximately one-fifteen thousandth of a second with an intensity of about two million international candles is employed. This light source makes it possible to obtain photographs with great depth of field and quite free from the blur produced by motion. Magnifications of 35 diameters were used in the present study.

The diagnostic value of limbal capillaries in ariboflavinosis is questioned. In order to be sure as to formation of new vessels from this condition tests should be made after the instillation of histamine. It is only after the use of

histamine that all of the existing capillaries are filled sufficiently to be observed. The aqueous veins may be easily studied in the photographs. Layering of blood and aqueous in some of the channels makes them easily recognized. These vessels may be of particular importance in the study of glaucoma. The effect of physostigmine, pilocarpine, and epinephrine on the capillaries is described. The results of a few studies indicate that the conjunctival blood vessels react to histamine in a normal person in a manner similar to the reaction to allergins in an allergic patient. (11 illustrations, references.) John C. Long.

Gurley, L. M., Jr. **Pterygium transplantation by simplified method.** U. S. Naval Med. Bull., 1944, v. 43, Dec., p. 1114.

The author describes a blunt dissection method consisting of the passage of a muscle hook beneath the neck of a pterygium and then by a combination of teasing and rocking motion slowly carrying the hook to the head of the pterygium until the growth is cleanly torn away from its corneal attachment. A conjunctival forceps fixed to the body of the pterygium serves for stabilization. No pericorneal conjunctival incision is made. Instead, using the conjunctival opening at the lower margin of the pterygium, the conjunctiva is undermined to the midline by tenotomy scissors. The head of the pterygium is then buried beneath this covering by means of a fine doubly-armed silk suture. Occasionally an exposed area may persist between the superior conjunctival lip and the superior edge of the now transplanted pterygium, but this can be obliterated with one interrupted suture. (4 drawings.)

Owen C. Dickson.

Leech, V. M. **Chronic conjunctivitis caused by cystoid degeneration of the upper canaliculus.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 400-403. (One figure, one reference.)

Loewenstein, Arnold. **The dionin effect in the conjunctiva.** Brit. Jour. Ophth., 1944, v. 28, Dec., pp. 622-625.

Examination of subconjunctival hemorrhages with the slitlamp showed the presence of perivascular lymph channels four or five days after the occurrence of the hemorrhage, when the blood was undergoing absorption. After instillation of 2 to 5 percent dionin into the conjunctival sac, the lymph sheaths were found to disappear with the onset of edema, and to reappear after the edema had subsided. (2 figures, references.) Edna M. Reynolds.

Loewenstein, Arnold. **Trachoma virus and inclusion bodies.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 282-287. (2 black and white plates, 2 figures, references.)

Patwardhan, D. G. **A case of plasmoma or plasmocytoma of the conjunctiva.** Indian Jour. Ophth., 1944, v. 5, April, p. 46.

A girl aged 15 years complained of heaviness and thickness of the right upper eyelid, of six months duration. The eyelids opened only about halfway. On eversion of the eyelid, a flattened cauliflower-like growth was seen on the surface of the palpebral conjunctiva. It bled slightly. There was no trace of pannus. There was a history of a meibomian cyst having burst spontaneously. The growth was excised with the tarsal plate. The nodule had papillary projections and a well-formed fibrous capsule. It was traversed by a number of well-formed bloodvessels.

Microscopic study showed typical plasmoma cells. W. H. Crisp.

Rodin, F. H. **Bacteriologic study of human conjunctival flora.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 306-314. (5 tables, references.)

Rosenblum, H. H. **So-called Reiter's disease; the triad of acute arthritis, conjunctivitis, and urethritis.** U. S. Naval Med. Bull., 1945, v. 44, Feb., p. 375.

This disease is a triad of acute arthritis, conjunctivitis, and urethritis. Having seen ten cases the author doubts that the condition is a rare one. The conjunctivitis is described as acute but of moderate degree although with purulent discharge. Serologic and bacteriologic studies were all negative. Sulfathiazole, sulfadiazine, sodium salicylate, and colchicine failed to help.
F. M. Crage.

Seelig, C. A. **Gonorrheal ophthalmia; treatment with intraocular penicillin.** U. S. Naval Bull., 1945, v. 44, Feb., p. 389.

The author reports a case of gonorrheal ophthalmia with kerato-iritis and two large peripheral serpiginous corneal ulcers in a man aged 35 years. The smears were positive. Sulfathiazole, penicillin intramuscularly, iodine locally to the ulcers, and triple typhoid-vaccine injections did not help.

Subconjunctival injections of penicillin, corneal baths of penicillin, and trichloracetic acid applied locally to the ulcers brought a cure in 29 days. The resultant vision was 20/20. Subconjunctival injections of 0.25 c.c. containing 1,250 units of penicillin were used every four days. F. M. Crage.

Sorsby, A., and Hoffa, E. **Local penicillin for ophthalmia neonatorum.** Brit. Med. Jour., 1945, Jan. 27, p. 114.

A report is given of 47 cases of ophthalmia neonatorum treated by local application of penicillin in the form of drops. Concentrations of 500, 1,000, 1,500, and 2,500 Oxford units per c.c. were used. The cases were divided into four series. The cases treated with the 2,500-unit concentration, 22 in number, gave 21 cures, the largest proportion of satisfactory results of the four series. Penicillin seemed to be equally effective against all the common causal organisms of the disease. Diphtheroids and inclusion-body organisms seemed to be most resistant. After initial irrigation with half-normal saline at body temperature, one drop of penicillin is instilled. It is repeated half-hourly for the first three hours, then hourly for 24 hours, and every two hours thereafter. It is continued for 48 hours after clinical cure, at two-hour intervals during the day and three-hour intervals at night. Preinstillation irrigation is practised as long as discharge is present. Except for occasional mild transient injection of the conjunctiva, the drug is well tolerated by these eyes. In some instances recovery was a matter of a few hours. On the whole the results are considered to be parallel with those obtained from the sulfonamides.
F. M. Crage.

Town, A. E. **Gonorrheal ophthalmia treated with penicillin.** U. S. Naval Bull., 1945, v. 44, Feb., p. 387.

A marked case of gonorrheal ophthalmia in a male aged 22 years was treated with penicillin injections intramuscularly. There were no more gram-negative diplococci 48 hours after therapy was started. The only local treatment used was atropine, because there were no complications. F. M. Crage.

6

CORNEA AND SCLERA

Bellows, J. G. **Krukenberg spindle and its relation to annular pigmented band on periphery of the lens.** Arch. of Ophth., 1944, v. 32, Dec., pp. 480-482.

The mechanism for formation of the pigment band known as the Krukenberg spindle is not clearly understood. The corneal pigment is derived either from degenerative changes in the iris or, if the spindle is associated with a pigment ring on the periphery of the lens, from the pigment markings on the surface of the lens. It is likely that alterations in the corneal endothelium must take place before the fine pigment granules can adhere to the cornea. The greater frequency of the Krukenberg spindle in females, particularly women past the menopause, supports the theory that endocrine dysfunction plays a part in its formation.

Within less than a week the author observed this rare pigment abnormality in two young persons in an Army hospital. The first patient was a seaman aged 28 years who appeared for a routine ocular examination. A fusiform streak composed of fine brown particles was observed on the posterior surface of the right cornea. The left eye showed no corneal streak but did show pigment particles near the pupillary border of the iris. Two weeks later a typical Krukenberg spindle appeared in the left eye. The second case was encountered in a nurse aged 21 years. Bilateral Krukenberg spindles were observed associated with a dense brown pigmented ring visible around the entire circumference of the lens, almost coinciding with the margin of the completely dilated pupil. It is thought that the pigmented markings of the lens result from abnormal maintenance of contact between the tips of the ciliary processes and the lens in early life. (2 illustrations, references.) John C. Long.

Bilger, Izzet. **Local application of vitamin A to the eye.** Göz Klinigi, 1944, v. 1, no. 6, p. 219.

Good results are reported from local application of vitamin-A drops (Vogan) in several cases of superficial corneal disease. Joseph Igersheimer.

Braley, A. E. **Epidemic keratoconjunctivitis.** Arch. of Ophth., 1945, v. 33, Jan., pp. 47-55. (See Section 5, Conjunctiva.)

Caire, Lincoln. **Considerations regarding case of keratoconus.** Rev. Brasileira de Oft., 1944, v. 3, Dec., pp. 65-72.

The patient, whose age is not given, had vision of less than 1/20 for the right eye and 1/10 for the left eye, without correction. The right eye obtained vision of 8/10 with minus 17.50 cylinder axis 70 degrees, and the left eye vision of 1.0 with minus 5.25 cylinder axis 95 degrees combined with 4 D. sphere. These lenses were completely tolerated and were therefore prescribed. The patient was subjected to intravenous and intramuscular injections of a form of antimony, and after two months showed no modification in axis or strength of correction, or in visual acuity. (References.)

W. H. Crisp.

Pullinger, B. D., and Mann, I. **Avascular healing in the cornea.** Jour. Path. and Bact., 1943, v. 55, pp. 151-158. (See Section 16, Injuries.)

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Bellows, J. G. **Pigmented lines in retroiridal region of anterior capsule**

of lens. Arch. of Ophth., 1944, v. 32, Dec., pp. 483-484.

Radial pigmented lines have been observed to occur on the anterior surface of the lens. These lines can be seen only with the slitlamp and usually require mydriasis. The lines are delicate and radially directed, and if present in all sectors they form a wreath. The striae are variable in size. The total number of lines ranges from less than ten to several hundred. In some sections they lie close together, whereas in others they may be represented by only a solitary line. According to Vogt's hypothesis these lines are a vestige of the capsulopupillary membrane. Streiff and Bischler state that the lines are remnants of the pupillary membrane which at first are nonpigmented but which may become pigmented in elderly persons as a result of disintegration and freeing of the pigment of the iris.

The author reports two cases of this condition. The first patient, a man of 57 years, showed delicate brown radial streaks, forming a wreath, on the anterior capsule of each lens. The other patient, a soldier aged 27 years, showed the same anomaly. This is the first time that pigmented lines have been reported in a subject under the age of 40 years. (One illustration, 2 tables, references.) John C. Long.

8

GLAUCOMA AND OCULAR TENSION

Allen, T. D. **Congenital glaucoma and cataract, bilateral; goniotomy and needling.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 388-392.

9

CRYSTALLINE LENS

Allen, T. D. **Congenital glaucoma and cataract, bilateral; goniotomy and needling.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 388-392.

Bellows, J. G. **Krukenberg spindle and its relation to annular pigmented band on periphery of the lens.** Arch. of Ophth., 1944, v. 32, Dec., pp. 480-482. (See Section 6, Cornea and sclera.)

Bellows, J. G. **The crystalline lens in diabetes mellitus.** Arch. of Ophth., 1944, v. 32, Dec., pp. 498-507.

This article is a detailed review of the lens changes in diabetes. Since most of the visual disturbances in diabetic patients occur after the age of 40 years, it is difficult to differentiate between merely senile changes and changes actually due to diabetes. Nevertheless, there appears to be a significant relation between the incidence of ocular disease and diabetes. Well over half of the diabetic visual disturbances are due to changes in the lens and retina. Two types of abnormality of the lens appear: (1) transitory refractive changes and (2) diabetic cataract.

The transitory refractive changes may give rise to either myopia or hypermetropia. Such myopia occurs only in cases of fresh diabetes with a high level of blood sugar and is less common and of lesser degree than diabetic hyperopia. The hyperopia always follows the myopia before a return to the normal refractive state. Hyperopia, on the other hand, may arise without preceding myopia. Hyperopia appears only when the patient's general condition begins to improve, and regression to the normal state is gradual, generally requiring two to four weeks. Weakness of accommodation accompanies hyperopia in persons under thirty years of age. The author discusses the numerous anatomic and physiochemical theories advanced to explain the refractive changes.

Statistics on diabetic cataract are extremely difficult to interpret, as the values are vitiated by the frequency with which the term has been used to apply to any cataract in a diabetic person. More accurately, it should refer to the characteristic cataract found in young persons with diabetes. In older diabetics the cataract becomes indistinguishable from senile cataract. Some observers state that diabetes may aggravate or hasten opacification of the lens initiated by senility. Since the effects of diabetes are in many respects similar to those of age, a diabetic person might be expected to show signs of senility which otherwise would not appear for many years.

Various theories are given to explain the pathogenesis of diabetic cataract. It is characterized by the appearance, under the capsule of each lens, of fluid vacuoles which progress to complete opacity in periods of a few weeks to six months. Goulden (see Amer. Jour. Ophth., 1930, v. 13, p. 78) pointed out that the typical subcapsular opacities invade the space between the capsule and the band of disjunction, whereas in all other forms of cataract this space remains clear.

Control of the diabetic condition seems in many cases to be beneficial as to diabetic cataracts. Vigorous insulin treatment may delay or arrest the process in the lens, or may even in rare cases cause regression of recent diabetic opacities. Insulin has been of great value in preoperative preparation for removal of cataracts in diabetics. Before the use of insulin, the operation for such cataracts was attended by very serious dangers from infection and hemorrhage. (Bibliography.)

John C. Long.

Dunnington, J. H. **Some complications of cataract extraction.** New York State Jour. Med., 1944, v. 44, Oct. 15, p. 2224.

Hemorrhage into the anterior chamber usually occurs from the wound rather than from the iris. Unless very severe, it clears without producing any serious effect upon the ultimate visual result. The proper treatment consists of complete bed rest and thorough atropinization. Hot compresses frequently do more harm than good. Iris prolapse results from faulty reposition of the iris, defective wound closure, or subsequent wound rupture. Corneoscleral sutures do much to prevent its occurrence. Prompt excision of all prolapses is advised, with the possible exception of small ones adequately covered by conjunctiva. Delayed restoration of the anterior chamber usually means either faulty wound closure or the presence of a filtering cicatrix. Proper toilet of the wound and adequate sutures are the best prophylactic measures. Prompt repair of all leaking wounds will lessen the incidence of epithelization of the anterior chamber and postoperative glaucoma. Theodore M. Shapira.

Ramón Roda, J. **Detachment of the retina in aphakic eyes.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 199-204. (See Section 10, Retina and vitreous.)

10

RETINA AND VITREOUS

Arruga, H. **When to operate in detachment of the retina.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 205-208.

During the period of bed rest prior to operation for retinal detachment the case may follow any of three courses. In the first, the retina settles down in

the region of the tear. As soon as this condition has been obtained the operation should be done. In the second group, the detachment remains unchanged with rest in bed. This is seen most usually with the disinsertions, wherein nothing is to be gained by waiting for reapplication of the retina. The same is true in the case of small tears with an altered choroid which does not readily absorb the subretinal fluid. If there is a very large tear, the choroid may not be able to absorb the large amount of fluid which passes through the tear. Here, by emptying the subretinal fluid, an initial operation may save the macular vision and make more favorable a second operation. In the third group of cases, the detachment becomes worse despite bed rest. This probably indicates a choroiditis, in which event the operation should be postponed.

J. Wesley McKinney.

Ballantyne, A. J., and Loewenstein, A. **Retinal micro-aneurysms and punctate hemorrhages.** Brit. Jour. Ophth., 1944, v. 28, Dec., pp. 593-598.

Many, if not most, of the so-called deep punctate hemorrhages characteristically seen in diabetic retinopathy are shown to be capillary aneurysms, mostly in the inner nuclear layer, in the course of the capillaries which link the deeper and the more superficial capillary plexuses of the retina. The aneurysms show a remarkable uniformity in size and have the appearance of globular collections of red blood cells enclosed in walls of varying thickness. They may be a source of hemorrhage, but many of them are seen to undergo a process of thrombosis and cicatrization. They represent a stage in the vicious circle in which changes in the capillary endothelium lead to stasis in the circulation, which in turn causes further vascular changes, especially on the venous side. (12 illustrations, references.) Edna M. Reynolds.

López Enriquez, M. **Ophthalmoscopic examination during operation for retinal detachment.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 224-226.

Stressing the importance of ophthalmoscopic control during the operation for retinal detachment, the author advises a minimum instillation of local anesthetic preoperatively, dispensing with the use of adrenalin and instillations of saline, and, most important, keeping the cornea covered with the lid by not using a speculum.

J. Wesley McKinney.

Macgregor, I. S. **Bilateral partial ectasia of the nerve head with peripapillary ectasia.** Brit. Jour. Ophth., 1944, v. 28, Dec., pp. 618-622.

A case of partial bilateral excavation of the disc below, with complete wide scleral halo and gross pigmentary disturbance in a child aged seven years, is reported. The margins of the discs were best seen with −6.00 diopters and the floor of each cup with −18.00 diopters. The central fundus and the periphery were best seen with no correcting lens in the ophthalmoscope. No macular reflex could be seen in either eye. The fields showed a definite wedge defect in each eye. The tension was normal. The anterior segments of the eyes were normal. The Wassermann was negative and the mother's eyes were normal. The case is reported because it differs from other similar cases reported in the literature in that the discs were not completely excavated. (4 figures, references.) Edna M. Reynolds.

Poyales. **Vitreous hemorrhage in the surgical treatment of retinal detachment.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 219-223.

Hemorrhages may be immediate or delayed, occurring several days after operation. The best treatment is prophylaxis. A thorough study for blood dyscrasia is carried out before the operation and if the slightest abnormality is found coagulant drugs are given. At operation it is important to avoid the venae vorticosae and not to use too strong a current. If hemorrhage occurs immediately, surface diathermy should be used in the surrounding area to cause thrombosis of the vessels. After three weeks short-wave diathermy may be used to promote absorption of the blood. J. Wesley McKinney.

Prior Guillem, Antonio. **New separator for the operation of retinal detachment.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 209-210.

An instrument is described for separating the tissues about the globe to increase the field of view during the operation. J. Wesley McKinney.

Ramón Roda, J. **Detachment of the retina in aphakic eyes.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 199-204.

The incidence of retinal detachment in aphakia as reported by various authors was noted to vary between 1 and 2.5 percent. The author speculates on the causes of detachment after uncomplicated cataract extraction. No definite conclusions are drawn. (One color plate, including 4 figures.)

J. Wesley McKinney.

Salgado Benavides, Enrique. **A new case of von Hippel's disease.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 194-196.

A case is reported with colored drawings. No mention of treatment is made.

Salgado Benavides, Enrique. **Three cases of Stargardt's disease.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 185-193.

Stargardt's disease is a familial retinal degeneration beginning at the macula and of unknown etiology.

The disease is progressive and may be divided into three phases. In the first phase, vision is reduced but no retinal lesion can be seen. In the second stage yellowish spots surrounded by pigment develop in the macular region. Finally large degenerative foci are seen throughout the retina. The process does not produce total blindness. Three cases are reported from a single family. (One color plate.)

J. Wesley McKinney.

Von Sallmann, L. **Hydrogen-ion concentration of the vitreous in the living eye.** Arch. of Ophth., 1945, v. 33, Jan., pp. 32-39.

The concept of the relation of even small changes in hydrogen-ion concentration to vital biochemical and biophysical processes has stimulated many studies on acid-base equilibrium in various body fluids and tissues. The interest of ophthalmologists has been focused mainly on one phase of this relationship, that is, the changes in turgescence of colloids due to a shift in the hydrogen-ion concentration.

The author gives a technical description and discussion of his experiments on hydrogen-ion concentration in the living eye. A glass electrode of the thin-membrane type was designed for determination of the p_H in circumscribed areas of the vitreous in vivo.

Accurate measurements of temperature in the examined area were obtained by use of a thermocouple. A range in pH of 7 to 7.10 was recorded for the normal vitreous of rabbits. There was a trend toward increase of hydrogen-ion concentration in the cortical layers of the vitreous. This shift may be the result of acid formation caused by high glycolytic activity of the retina.

Local acidosis, up to a pH of 5.7, developed in the eary stages of an acute staphylococcic infection of the vitreous. The acidity decreased during the following weeks. Several months after the inflammation had been arrested by penicillin, a normal range of pH was restored in the vitreous, or the acidity was succeeded by a slight alkalosis. In eyes in which the retina had been partially destroyed by systemic treatment with sodium iodate, readings indicated higher alkalinity than for normal eyes. (One diagram, one table, references.) R. W. Danielson.

Theodore, F. H., and Bonser, W. H. **Congenital arterial aneurysm at the papilla.** Arch. of Ophth., 1944, v. 32, Dec., pp. 492-495.

Considerable confusion exists in the classification of aneurysms of the retinal vessels. The cases previously reported may be classified as follows: (1) aneurysms of the larger branches of the central retinal artery, all of which appear to have been secondary to vascular disease or trauma, and which are generally associated with visual impairment; (2) miliary aneurysms, which are of two types, one essentially a senile degenerative phenomenon, the other neoplastic, and (3) arteriovenous aneurysms, essentially congenital in origin.

The author describes an aneurysm that does not correspond exactly to any previously described. The patient was an aviation cadet of 19 years with 6/5 vision in each eye. The left optic disc was almost entirely obscured by a serpentine aneurysmal dilatation of the inferior temporal artery, which occupied the temporal seven eighths of the nerve head. The aneurysm consisted of sausage-like, saccular coils of artery, dilated to at least four times the normal diameter. These were connected by narrow, vermiform portions and contained blood. Moderately dense glial tissue covered all but the summits of the larger dilatations and extended beyond the margins of the aneurysm to obscure the margins of the disc. The aneurysm did not pulsate but carotid pressure caused it to collapse partially. Except for the region of the disc, there were no arterial abnormalities. (One illustration, references.)

John C. Long.

Yudkin, Simon. **The effect of the duration of stimulus on threshold measurements in the dark-adapted eye.** Brit. Jour. Ophth., 1944, v. 28, Dec., pp. 611-617.

A series of experiments carried out on about 600 airmen at an R.A.F. station in England are reported. The dark-adapted rod thresholds of these men were measured on three occasions at intervals of three weeks. On each occasion the threshold of each man was measured, using two different periods of exposure. One of these was 0.2 second and the other 0.02, 0.04, 0.1, 0.5, or 1 second, the same two exposures being used for each man for all three tests. Thus all the men were tested with the 0.2-second exposures and from 60 to 115 men with each of the other exposures. During the intervals between tests, the men received various vitamin or dummy tablets. No specific effect

on the thresholds was produced by any of these supplements, so that the results for each exposure may be considered independently of any treatment given.

The mean threshold was found to be lower for the longer durations up to 0.5 second, but the lowering of the threshold was not proportional to the increased duration of exposure. The range of the thresholds for all the groups was the same whatever the exposure. The variability of individual thresholds from test to test was least with the 0.2-second exposure and more for all the other exposures. (One drawing, 3 tables, references.)

Edna M. Reynolds.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Carroll, F. D. **Visual symptoms caused by digitalis.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 373-376; also Trans. Amer. Ophth. Soc., 1944, v. 42. (One table, references.)

Hardy, Guerdan. **Maxillary sinusitis with optic neuritis.** Amer. Jour. Surg., 1944, v. 66, Oct., p. 126.

A careful study of the paranasal sinuses is indicated when retrobulbar or optic neuritis occurs. In one case of maxillary sinusitis with optic neuritis, the author found that, whereas conservative treatment resulted in slight improvement in visual acuity, rapid betterment and ultimate normal vision followed the removal of infected tissue from the maxillary sinus. It is fair to conclude that the infection within the antrum was the cause of the optic neuritis. Conservative measures should be instituted while the search for foci of infection is progressing, but once a focus is definitely established it must be eliminated without delay.

Theodore M. Shapira.

Kravkov, S. V., and Mursin, A. N. **Electrical sensitivity of the eye in some optic-nerve diseases resulting from cranio-cerebral traumata.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 363-369. (5 figures, one table, references.)

Moehle, Walter. **Complete congenital pigmentation of the optic disc.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 377-380. (References.)

12

VISUAL TRACTS AND CENTERS

Hartmann, Edward. **Optochiasmic arachnoiditis.** Arch. of Ophth., 1945, v. 33, Jan., pp. 68-77.

Hartmann's definition of optochiasmic arachnoiditis is a localized inflammatory process at the base of the brain, affecting the chiasm and the optic nerves, as well as the meninges which surround them. As to frequency, statistical data do not give a true picture, since the disease is not widely known and its existence as an entity is not universally accepted.

The lesions encountered may, rather artificially, be separated into three types: thickening and adhesions of the arachnoid, circumscribed collections of fluid, and atrophy of the optic nerves and chiasm. Any one of these three types rarely occurs alone but merely predominates, and the relative proportion is variable. Of a group of 129 cases, the total number in which possible causes were found was 81. The most frequent were infection of the nose and sinuses, trauma, and syphilis. The mechanisms of action are direct pressure, inflammatory processes, and impaired blood flow.

The diagnosis depends upon field defects, lowering of visual acuity, fundus changes, and other symptoms, combined with roentgenographic evidence. The field defects and fundus changes are quite varied. Contrary to what usually occurs in cases of pituitary adenoma, the visual acuity fails at an early stage of the disease. Roentgenologic studies show none of the signs usually found with sellar or suprasellar tumors. The sella is not enlarged, and air studies usually prove the ventricles to be of normal size and location.

If nonoperative treatment brings no improvement, especially if vision and fields continue to fail, surgical intervention should not be delayed too long. The chiasmic region can now be explored with but slight mortality. The visual results are far from being as favorable as those following removal of a tumor, but have been far better when operation was done in the early stages of the disease. (Bibliography.)

R. W. Danielson.

13

EYEBALL AND ORBIT

Abundio Alvárez. **Sulfonamides in the treatment of panophthalmitis.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 233-237.

A case of panophthalmitis is reported whose symptoms subsided rapidly under sulphonamide therapy. The final result was atrophy of the globe. (One photograph.) J. Wesley McKinney.

14

EYELIDS AND LACRIMAL APPARATUS

Brav, Aaron. **Accidental vaccinia of the eyelid with disciform keratitis.** Arch. of Ophth., 1945, v. 33, Jan., p. 67.

The author reports such a case in a 14-year-old girl. (One photograph.)

R. W. Danielson.

Gifford, Harold, Jr. **Dacryocystitis. The transplantation operation.** Arch. of Ophth., 1944, v. 32, Dec., pp. 485-487; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1944, 94th mtg.

The etiologic factor in the infantile type of dacryostenosis is the failure of the lower end of the nasolacrimal duct to open soon after birth. If this end fails to open when lacrimation starts, the sac cannot empty and soon becomes infected. The mucous glands hypertrophy and a mucocele develops within a month or two. Out of 37 cases of the infantile type, in 19, or about one half, cure was effected without surgical intervention. The duct was probed in the other 18 cases, cure being effected in all but four. In all four cases in which probing failed to cure the stenosis, the probing had been done before the age of six months. The author believes that probing should never be done before the age of six months. When the lower end of the duct becomes patent, spontaneous cure will take place. Direct pressure on a full sac exerted down toward the canal will hasten this result. If probing becomes necessary it is done under light ether anesthesia, using only the smallest probe so that little damage is done to the lining of the lacrimal duct.

The etiology of the adult forms is not so simple. Trauma, infection of the sac, tumors, and nasal pathologic processes account for most of them. Acute dacryocystitis can be more effectively treated when the sulfonamide compounds and penicillin are used. An attempt is made to empty the sac by gentle pressure and lavage, but no probing is done beyond the canalicu-

lus. If this measure fails, the sac should be incised deeply and sulfanilamide powder dusted in or carried in with a drain.

An atrophic sac presents the problem of tearing only, since it rarely becomes reinfected and there is no danger to the cornea. In such cases the Arruga technique may be applied, or the secretory duct from the lacrimal gland may be excised safely if tearing is annoying.

In nearly 90 percent of the cases, mucocele can be cured by dacryocystorhinostomy. The author uses a technique that has been elaborated by Burch, Speciale-Cirincione, and Stokes. The lower end of the sac is freed through an external approach; a trephine opening, 8 mm. in diameter, is made into the nose, and the open lower end of the sac is held in place in the nose by sutures pulled out on the cheek. Results of this operation in 85 cases are tabulated. (4 tables, references.) John C. Long.

Gray, H. **Trichomegaly or movie lashes.** Stanford Med. Bull., 1944, v. 2, Nov., p. 157.

The author describes a case of giant or elongated eyelashes in a male aged 64 years. The lashes measured 20 and 22 mm. long. The condition existed also in the patient's daughter, and this suggested heredity as a possible etiologic factor. The term trichomegaly is proposed for the condition. F. M. Crage.

Hendricks, L. J. **Operation on the punctum lacrimale.** Arch. of Ophth., 1944, v. 32, Dec., p. 496.

In most cases of dacryocystitis an operation on the lacrimal point with subsequent gentle probing of the lacrimal duct into the nose will make dacryocystectomy unnecessary. Slitting, with probing of the lacrimal duct, helps in relief of congenital stenosis of the duct in infants, acute and chronic dacryocystitis, chronic catarrhal conjunctivitis, catarrhal ulcer of the cornea, senile spastic ectropion and entropion, and that annoying epiphora so often seen in older people. A probe slightly larger than a blunt-pointed darning needle is inserted into the sac through the inferior punctum. After the probe is passed into the sac, the canaliculus is slit with a probe-pointed knife, the actual incision being made slightly on the conjunctival side of the lid. Between one third and one half the distance between the punctum and the inner canthus is incised. The incision must be kept open until the edges are healed. At each visit the duct is probed all the way to the nose. Larger and larger probes are used, but there does not seem to be any necessity for using an instrument larger than a no. 5 or no. 6 Bowman probe. (References.)

John C. Long.

Leech, V. M. **Chronic conjunctivitis caused by cystoid degeneration of the upper canaliculus.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 400-403. (One figure, one reference.)

Simpson, G. V. **Sulfadiazine in treatment of dacryocystitis of the newborn.** Arch. of Ophth., 1945, v. 33, Jan., pp. 62-66.

The treatment of simple epiphora, or of epiphora complicated by dacryocystitis, occurring soon after birth is based on the premise that an obstruction is present at some point along the nasolacrimal duct. The types of obstruction may well be considered as either anatomic or accidental. A résumé of the literature on the use of sulfonamides in dacryocystitis is given.

In this paper the emphasis is placed

on the element of infection and its cure. When a case of congenital epiphora with dacryocystitis is seen for the first time, it is impossible to know whether an anatomic obstruction exists, and for that reason chemotherapy in conjunction with other conservative treatment is to be recommended in all cases. It is probable that such treatment, especially if instituted early, will result in surgical treatments being required in fewer cases. The author reports two cases in which a satisfactory response was obtained by administration of sulfadiazine. (References.)

R. W. Danielson.

Spake, L. B. **Chronic dacryocystitis. Treatment from the rhinologist's point of view.** Arch. of Ophth., 1944, v. 32, Dec., pp. 488-491; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1944, 94th mtg.

Chronic dacryocystitis may be classified as follows: (1) infection of the sac with intranasal abnormalities; (2) infection of the sac with involvement of accessory nasal sinuses; (3) infection of the sac without intranasal involvement; (4) recurrent infections of the sac with or without a fistulous tract or stenosis of the duct.

Careful attention to the intranasal condition should be given before attempting an external surgical procedure. The technique of the Mosher-Toti operation is given in detail. With this method the author has had successful results in 80 percent of cases of chronic suppurative dacryocystitis. (References.)

John C. Long.

16
INJURIES

Blake, P. M. **Injuries to the eye or to the intracranial visual paths in air-raid casualties admitted to hospital.** Brit. Jour. Ophth., 1945, v. 29, Jan., pp. 1-5.

This is a report on 764 cases admitted to the hospital on account of injuries in air raids. Eighty of this number died of their wounds. Of the remainder, 66 suffered either direct ocular injury or some intracranial injury which affected vision. Twenty-nine of these 66 had either complete or partial blindness. There were 14 cases of penetrating wounds, 3 of them bilateral. Ten patients suffered fractures of the skull or orbit which impaired vision.

Edna M. Reynolds.

Chandler, P. A. **Recurrent erosion of the cornea.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 355-363; also Trans. Amer. Ophth. Soc., 1944, v. 42. (Bibliography.)

Gallego Fernández, Antonio, **Histologic notes.** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 177-184.

In an eye enucleated on account of a perforating wound with loss of a large amount of vitreous, an anomalous position of many retinal cones in front of the external limiting membrane was found.

A case is reported of a hitherto undescribed retinal lesion resulting from improper use of X ray in treatment of carcinoma of the upper lid. The exact dosage of X ray given was not noted. The eye was enucleated on account of necrosis of the cornea with perforation. The retina was found to be infiltrated with round cells and a low detachment was present in the macular region. Deformation of Nissl bodies, vacuolization and picnosis of the nuclei of ganglion cells, and vacuolization of the

cones were the most notable lesions. (7 figures.) J. Wesley McKinney.

Oaks, L. W. **Improved treatment for chemical burns of the eye.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 370-373. (References.)

Pullinger, B. D., and Mann, I. **Avascular healing in the cornea.** Jour. Path. and Bact., 1943, v. 55, pp. 151-158.

In an investigation of the clinical pathology of experimental lesions made with liquid dichlorodiethylsulphide (mustard gas) in the eyes of rabbits, it was found that spontaneous avascular healing invariably followed if the applications of the liquid droplets damaged the center of the cornea alone and left the corneoscleral junction uninjured and free from edema, the end result being either restoration of complete transparency or the formation of faint nebulae of varying degrees of opacity, without blood vessels. To determine the nature of the cells which invade the cornea, healthy rabbits with cornea free from signs of permanent damage were given intravenous injections of 5 c.c. of a 5-percent-solution of a dye (Pontamine sky blue 6 BX) before application of the liquid mustard gas to the cornea. The animals were killed at various stages of healing, and the corneas fixed and cut for microscopic examination. Injuries were also produced by certain other chemical agencies. In vitally dyed animals, invasion of the substantia propria, during healing, by wandering cells in numbers far greater than normal was observed. Some of the wandering cells acted as macrophages, others were transformed into keratoblasts and fibrocytes. A transformation of others into corneal corpuscles seemed probable. (2 plates, including 13 photomicrographs, references.) W. H. Crisp.

Rodin, F. H. **Chart for recording location of corneal injuries and lesions.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 405-406. (2 charts, one reference.)

Scobee, R. G. **Penicillin in the treatment of perforating ocular injuries and in uveitis.** Amer. Jour. Ophth., 1945, v. 28, April, pp. 380-387. (11 figures, references.)

Sertorio Senna, **Extraction of nonmagnetic intraocular foreign bodies under radioscopic examination,** Arch. de la Soc. Oft. Hisp.-Amer., 1944, v. 4, March-April, pp. 227-232.

In two cases reported, bird shot was extracted from the vitreous by means of a forceps guided by fluoroscopy. (8 illustrations.)

J. Wesley McKinney.

Thorpe, H. E. **A new corneal splinter forceps.** Arch. of Ophth., 1944, v. 32, Dec., p. 497; also Trans. Sec. on Ophth., Amer. Med., Assoc., 1944, 94th mtg.

A modification of a pair of fine watchmaker's tweezers has proved helpful in the removal of splinters of wood, thorn, or brass from the cornea. The sharply pointed tweezer blades have several parallel grooves filed on their opposing inner surfaces. These grooves slant backward, so that backward-pointing steel ridges give a vise-like hold on the object grasped. (4 drawings.)

John C. Long.

Thorpe, H. E. **Shell for roentgenographic localization of intraocular foreign bodies.** Arch. of Ophth., 1944, v. 32, Dec., p. 497; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1944, 94th mtg.

The author describes a modification of the Comberg contact lens for intraocular localization. The Comberg lens is sometimes displaced by the lid. To avoid this difficulty three small holes are drilled into the contact lens so that scleral sutures may be used to secure it in place. Sometimes suction develops between the shell and the eyeball, causing difficulty in removal. This is avoided by drilling a small vent hole. An additional improvement is constructing the shell of plastic instead of glass. (One illustration.)

John C. Long.

Wright, R. E., and Duncan, H. A. G. **The giant magnet in ophthalmic battle casualties.** Brit. Med. Jour., 1944, Nov. 18, p. 658.

A minute magnetic foreign body imbedded in the retina "3 disc-diameters down and in from the disc," after passing through the eyeball, was removed by the giant magnet at a third session, the last being made 17 days after the first session. The authors stress especially the great importance of patience and perseverance of operator and patient in such cases. Beak-shaped terminals are preferred to the blunt type because the field of magnetic action is less diffuse with the former and delivery more accurate. Diathermy applications to a scleral wound should be made at the end of the operation, as reaction from such treatment complicates the technique if more than one sitting becomes necessary.

F. M. Crage.

NEWS ITEMS

Edited by Dr. Donald J. Lyle
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News items should reach the editor by the twelfth of the month.

Deaths

Dr. Sigmund A. Agatston, New York, New York, died March 5, 1945, aged 68 years.

Dr. Howard S. Browne, Ponca City, Oklahoma, died January 27, 1945, aged 58 years.

Dr. Arthur H. Brownell, Oneonta, New York, died January 10, 1945, aged 80 years.

Dr. DeForest W. Buckmaster, Jamestown, New York, died February 3, 1945, aged 47 years.

Dr. Thomas W. Deachman, Chicago, Illinois, died March 25, 1945, aged 76 years.

Dr. Charles H. Evans, Danville, Illinois, died March 26, 1945, aged 69 years.

Dr. Alfred G. Farmer, Dayton, Ohio, died April 2, 1945, aged 67 years.

Dr. Michael L. Levitt, Philadelphia, Pennsylvania, died January 1, 1945, aged 65 years.

Dr. Lloyd C. Pierce, Harrisburg, Pennsylvania, died March 22, 1945, aged 48 years.

Dr. Joseph H. Potts, New Britain, Connecticut, died March 24, 1945, aged 65 years.

Dr. Charles J. Price, Mount Morris, Illinois, died March 20, 1945, aged 70 years.

Dr. Albert W. Roth, Tulsa, Oklahoma, died March 17, 1945, aged 71 years.

Dr. Joseph R. Wetherbee, Eugene, Oregon, died January 12, 1945, aged 73 years.

Dr. James E. Woods, Jackson, Georgia, died February 3, 1945, aged 76 years.

Miscellaneous

The Saint Louis Ophthalmic Society and the Department of Ophthalmology of Washington University offers an eight-months course for orthoptic technicians who will work under the supervision of ophthalmologists. The theoretical instruction will be given at the Oscar Johnson Institute and the practical work at the Saint Louis Ophthalmic Laboratory. The course is limited to three students; tuition $300. For information write to the Saint Louis Ophthalmic Laboratory, Missouri Theatre Building, 634 Grand Boulevard, Saint Louis 3, or to Dr. Lawrence T. Post, 640 South Kingshighway, Saint Louis 10.

The Columbia University College of Physicians and Surgeons in conjunction with the National Society for the Prevention of Blindness held a conference in industrial ophthalmology from May 7th to 11th. This course, conducted in

support of the government program for better visual conditions in industry, was opened by Dr. Willard C. Rappleye, dean of the Columbia University College of Physicians and Surgeons. Those participating in conducting the course were: Dr. Albert C. Snell, Rochester, New York, "Industrial challenge to ophthalmology"; Charles P. Tolman, New York, "Eyesight in industry"; Gertrude Rand, Ph.D., and W. G. Darley, New York, "Illumination from the viewpoint of ophthalmology and of industry"; Dr. Hedwig S. Kuhn, Hammond, Indiana, "Prescriptions for occupational glasses"; Joseph Tiffin, Ph.D., "Job analysis for visual requirements"; Faber Birren, New York, "Use of color for simplfying the visual task"; Lt. Comdr. Walter E. Fleischer (MC), "Welding hazards"; Dr. Leon H. Whitney, Brooklyn, "Vision, engineering, and management"; Dr. Charles F. Kutscher, Pittsburgh, "Industrial toxic compounds, hazards, and treatment"; and Dr. James M. Carlisle, Rahway, New Jersey, "Industrial first aid in chemical injuries of the eye."

Drs. Conrad Berens, Joseph Lo Presti, and Le Grand Hardy participated in a symposium on screening methods for industrial visual characteristics.

Societies

At the regular meeting of the Milwaukee Oto-Ophthalmic Society, held on April 24th, Dr. John R. Lindsay presented a paper, entitled "Ménière's disease."

The forty-third meeting of the Reading Eye, Ear, Nose, and Throat Society was held on March 21st at the Wyomissing Club, Reading, Pennsylvania. Dr. George M. Coates, Philadelphia, spoke on "Osteitis and osteomyelitis of the frontal bone."

The following officers were elected for the next fiscal year: Dr. Isaac B. High, president; Dr. C. W. Bankes, first vice-president; Dr. Michael J. Penta, second vice-president; Dr. Paul C. Craig, secretary; and Dr. John M. Wotring, treasurer.

At the April meeting of the Cleveland Ophthalmological Club Dr. Alan C. Woods, ophthalmologist-in-chief of Johns Hopkins University, spoke on "The pathogenesis and treatment of ocular tuberculosis." The officers elected for 1945 were: Dr. Paul Motto, president; Dr. James T. Collins, vice-president; and Dr. H. H. Wyand, secretary and treasurer.

Personals

Dr. Louis G. Hoffman has been appointed acting chairman of the department of ophthalmology of Loyola University School of Medicine, succeeding the late Dr. Carl F. Schaub.

On November 15, 1945, Col. Derrick T. Vail will deliver the next deSchweinitz Lecture before the Section on Ophthalmology of the College of Physicians of Philadelphia.

The Society of Kellogg Fellows of the Pan-American Congress of Ophthalmology was formed to help in bringing about a close relationship between the ophthalmologists of the Americas, and to aid in raising the level of the theory, practice, and teaching of ophthalmology in the Western Hemisphere. The society met last October, adopted the statutes of the organization, and elected the following officers: honorary president, Harry S. Gradle, M.D. (U.S.A.); president, Manoel da Silva, M.D. (Brazil); secretary, Olga Ferrer, M.D. (Cuba).

The membership of the society is now composed of 28 Kellogg Fellows from the following 18 countries: Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Paraguay, Peru, Puerto Rico, and Venezuela.—Olga Ferrer, Secretary, Institute of Ophthalmology of the Presbyterian Hospital of the City of New York.